

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



United States
Department of
Agriculture

Agricultural
Research
Service

ARS-8

August 1984

WGEN: A Model for Generating Daily Weather Variables

LIBRARY
-3 P 6:43
1984



ABSTRACT

Richardson, C. W., and D. A. Wright. 1984. WGEN: A Model for Generating Daily Weather Variables. U.S. Department of Agriculture, Agricultural Research Service, ARS-8, 83 p.

A computer simulation model called WGEN (Weather Generator) that provides daily values for precipitation, maximum temperature, minimum temperature, and solar radiation is described. The model accounts for the persistence of each variable, the dependence among the variables, and the seasonal characteristics of each variable. Its parameters are defined for locations in the United States, enabling use of the model in the 48 contiguous States without reference to actual data. Examples of model applications are given, and weather data generated by the model are compared with actual data.

KEYWORDS: weather, climate, precipitation, solar radiation, temperature, simulation model, Markov chain

Copies of this publication are available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Va. 22161.

ARS has no additional copies for free distribution.

CONTENTS

Introduction,	5
Model description,	5
Precipitation,	6
Temperature and solar radiation,	7
Precipitation and temperature correction,	10
The WGEN Program,	11
The WGEN PAR Program,	12
Results and discussion,	12
Summary,	14
Literature cited,	15
Tables,	16
Figures,	33
Appendixes,	35
Appendix A: Generation parameters,	35
Appendix B: Input data for WGEN,	59
Appendix C: The WGEN Program,	63
Appendix D: The WGEN PAR Program,	75

WGEN: A MODEL FOR GENERATING DAILY WEATHER VARIABLES

C. W. Richardson and D. A. Wright^{1/}

INTRODUCTION

Daily weather data are required for many applications. Weather data are frequently needed to aid in the design of hydraulic structures; to evaluate the effects of watershed changes on hydrology, water quality, or erosion; or to assess alternative crop or range management strategies. Mathematical models of the physical processes involved are often used to make these evaluations. In addressing the response of these processes to weather inputs, it is seldom sufficient to examine only responses to observed weather events. Use of only observed sequences gives a solution which is based on only one realization of the weather process. For some locations no weather data are available to make the desired assessment. It is desirable to have the capability of generating synthetic weather data with the same statistical characteristics as the actual weather at the location. Therefore, the purpose of this paper is to provide a method for generating samples of daily weather variables.

A computer simulation model called WGEN (Weather Generator) has been developed to generate daily values for precipitation, maximum temperature, minimum temperature, and solar radiation. The model is based on the procedure described by Richardson (1981); however, several assumptions have been made that simplify the use of the model. The model parameters that are required to generate new sequences of the weather variables have been determined for locations in the 48 contiguous States of the United States and are given in appendix A.

Several other models have been developed for generating sequences of daily weather variables (Jones et al. 1972, Bond 1979, Nicks and Harp 1980, Bruhn et al. 1980, Larsen and Pense 1981). These models are based on sound statistical principles; however, they lack the general applicability and ease of use that is afforded by WGEN, and the model parameters given in the appendix.

MODEL DESCRIPTION

WGEN provides daily generated values of precipitation (p), maximum temperature (t_{\max}), minimum temperature (t_{\min}), and solar radiation (r) for an n -year period at a given location. The occurrence of rain on a given day has a major influence on temperature and solar radiation for the day. The approach that is used is to generate precipitation for a given day independently of the other variables. Maximum temperature, minimum temperature, and solar radiation are then generated according to whether a wet day or dry day was previously generated. The model is designed to preserve the dependence in time, the correlation between variables, and the seasonal characteristics in actual weather data for the location.

^{1/}Agricultural engineer and computer programmer, respectively, USDA-ARS, Grassland, Soil and Water Research Laboratory, P. O. Box, 748, Temple, TX 76503.

Precipitation

The precipitation component of WGEN is a Markov chain-gamma model. A first-order Markov chain is used to generate the occurrence of wet or dry days. When a wet day is generated, the two-parameter gamma distribution is used to generate the precipitation amount.

With the first-order Markov chain model, the probability of rain on a given day is conditioned on the wet or dry status of the previous day. A wet day is defined as a day with 0.01 inch of rain or more. Let $P_i(W/W)$ be the probability of a wet day on day i given a wet day on day $i-1$, and let $P_i(W/D)$ be the probability of a wet day on day i given a dry day on day $i-1$. Then,

$$P_i(D/W) = 1 - P_i(W/W) \quad (1)$$

$$P_i(D/D) = 1 - P_i(W/D)$$

where $P_i(D/W)$ and $P_i(D/D)$ are the probabilities of a dry day given a wet day on day $i-1$ and the probability of a dry day given a dry day on day $i-1$, respectively. Therefore, the transition probabilities are fully defined given $P_i(W/W)$ and $P_i(W/D)$.

Several probability density functions have been used to describe the distribution of rainfall amounts (Smith and Schreiber 1974, Woolhiser and Roldan 1982). For this application, a distribution with a minimum number of parameters was needed to minimize the problem of defining the parameters for a large number of locations. Richardson (1982a) has shown the two-parameter gamma distribution to be significantly better for describing daily precipitation amounts than the simple one-parameter exponential distribution. The density function of the two-parameter gamma distribution is given by

$$f(p) = \frac{p^{\alpha-1} e^{-p/\beta}}{\beta^{\alpha} \Gamma(\alpha)}, \quad p, \alpha, \beta > 0 \quad (2)$$

where $f(p)$ is the density function of p , α and β are distribution parameters, $\Gamma(\alpha)$ is the gamma function of α , and e is the base of natural logarithms. The α and β are shape and scale parameters, respectively. For $0 < \alpha < 1$, $f(p)$ decreases with increasing p . The shape is appropriate for precipitation amounts since small amounts occur more frequently than larger amounts.

The values of $P(W/W)$, $P(W/D)$, α , and β vary continuously during the year for most locations. In WGEN, each of the four precipitation parameters are constant for a given month but are varied from month to month.

The values of each of the four parameters were determined by month for 139 stations in the United States, as shown in figure 1. The parameters were defined using 20 years (1951-70) of daily rainfall data for each station. The rainfall parameter values are given for each of the 139 stations in table A1. Rainfall parameters for other locations may be obtained by interpolation of values given in the same table. The parameters are used with a Markov chain generation procedure, and the gamma generation procedure described by Haan (1977) to generate daily precipitation values.

Temperature and Solar Radiation

The procedure that is used in WGEN for generating daily values of t_{\max} , t_{\min} , and r is that described by Richardson (1981). The procedure is based on the weakly stationary generating process given by Matalas (1967). The equation is

$$\chi_i(j) = A\chi_{i-1}(j) + B\epsilon_i(j) \quad (3)$$

where $\chi_i(j)$ is a 3 X 1 matrix for day i whose elements are residuals of t_{\max} ($j = 1$), t_{\min} ($j = 2$), and r ($j = 3$), ϵ_i is a 3 X 1 matrix of independent random components, and A and B are 3 X 3 matrices whose elements are defined such that the new sequences have the desired serial-correlation and cross-correlation coefficients. The A and B matrices are given by

$$A = M_1 M_0^{-1} \quad (4)$$

$$BB^T = M_0 - M_1 M_0^{-1} M_1^T \quad (5)$$

where the superscripts -1 and T denote the inverse and transpose of the matrix. M_0 and M_1 are defined as

$$M_0 = \begin{bmatrix} 1 & \rho_0(1,2) & \rho_0(1,3) \\ \rho_0(1,2) & 1 & \rho_0(2,3) \\ \rho_0(1,3) & \rho_0(2,3) & 1 \end{bmatrix} \quad (6)$$

$$M_1 = \begin{bmatrix} \rho_1(1) & \rho_1(1,2) & \rho_1(1,3) \\ \rho_1(2,1) & \rho_1(2) & \rho_1(2,3) \\ \rho_1(3,1) & \rho_1(3,2) & \rho_1(3) \end{bmatrix} \quad (7)$$

where $\rho_0(j,k)$ is the correlation coefficient between variables j and k on the same day, $\rho_1(j,k)$ is the correlation coefficient between variables j and k with variable k lagged 1 day with respect to variable j , and $\rho_1(j)$ is the lag 1 serial-correlation coefficient for variable j .

The correlation coefficients in equations (6) and (7) were determined by season from 20 years of temperature and solar radiation data for 31 locations in the United States (fig. 1). The seasonal and regional patterns of the correlation coefficients were described by Richardson (1982b). The seasonal and spatial variation in the correlation coefficients were relatively small. If the small variations are neglected and the average values of the correlation coefficients given by Richardson (1982b) are used, the M_0 and M_1 matrices become

$$M_0 = \begin{bmatrix} 1.000 & 0.633 & 0.186 \\ 0.633 & 1.000 & -0.193 \\ 0.186 & -0.193 & 1.000 \end{bmatrix} \quad (8)$$

$$M_1 = \begin{bmatrix} 0.621 & 0.445 & 0.087 \\ 0.563 & 0.674 & -0.100 \\ 0.015 & -0.091 & 0.251 \end{bmatrix} \quad \underline{2}/ \quad (9)$$

Using equations (4) and (5) the A and B matrices become

$$A = \begin{bmatrix} 0.567 & 0.086 & -0.002 \\ 0.253 & 0.504 & -0.050 \\ -0.006 & -0.039 & 0.244 \end{bmatrix} \quad (10)$$

$$B = \begin{bmatrix} 0.781 & 0 & 0 \\ 0.328 & 0.637 & 0 \\ 0.238 & -0.341 & 0.873 \end{bmatrix} \quad (11)$$

The A and B matrices given in equations (10) and (11) are used with equation (3) in WGEN to generate new sequences of the residuals of t_{\max} , t_{\min} , and r that are serially correlated and cross-correlated with the correlations being constant at all locations.

2/ The off-diagonal elements were calculated but not reported by Richardson (1982b).

The final daily generated values of t_{\max} , t_{\min} , and r are determined by multiplying the residual elements generated with equation (3) by a seasonal standard deviation and adding a seasonal mean using the equation

$$t_i(j) = \chi_i(j) \cdot s_i(j) + m_i(j) \quad (12)$$

where $t_i(j)$ is the daily value of t_{\max} ($j = 1$), t_{\min} ($j = 2$), and r ($j = 3$), $s_i(j)$ is the standard deviation and $m_i(j)$ is the mean for day i . The values of $m_i(j)$ and $s_i(j)$ are conditioned on the wet or dry status as determined from the precipitation component of the model. By expressing equation (12) in terms of the coefficient of variation ($c = s/m$) rather than the standard deviation, the equation becomes

$$t_i(j) = m_i(j) [\chi_i(j) \cdot c_i(j) + 1] \quad (13)$$

The seasonal change in the means and coefficients of variation may be described by

$$u_i = \bar{u} + C \cos(0.0172(i - T)), i = 1, \dots, 365 \quad (14)$$

where u_i is the value of the $m_i(j)$ or $c_i(j)$ on day i , \bar{u} is mean of u_i , C is the amplitude of the harmonic, and T is the position of the harmonic in days (fig. 2). Values of \bar{u} , C , and T must be determined for the mean and coefficient of variation of each weather variable (t_{\max} , t_{\min} , r) and for the wet or dry condition. These values were determined from the 20 years of daily weather data for the 31 locations and are given in tables 1-5. There were no detectable differences in the means and coefficients of variation for t_{\min} on wet or dry days; therefore, the values of \bar{u} , C , and T given in table 3 describe the seasonal variation in the mean and coefficient of variation of t_{\min} for both wet or dry days.

Some of the parameters in tables 1-5 are strongly location dependent while other parameters do not change significantly with location. The values of T for all the descriptors of temperature (means and coefficients of variation of t_{\max} and t_{\min}) were near 200 days for all locations. Similarly, the T values for r were about 172 days (summer solstice) for all locations. Therefore, in WGEN all the T values for temperature are assumed to be 200 days, and all the T values for solar radiation are assumed to be 172 days.

Most of the \bar{u} and C values in tables 1-5 were location dependent. The variable names that will be used for these parameters are given in table 6. The variables are defined graphically in figure 3. Contour maps for the parameters that had spatial trends are shown in appendix A.

The map of \bar{u} for the mean of t_{\max} on dry days is shown in figure A1. The amplitude (C) of the mean of t_{\max} for a given location was not significantly different on wet or dry days. The map of C for the mean of t_{\max} (wet or dry) is given in figure A2. The \bar{u} 's for the coefficient of variation of t_{\max} are given in figure A3. The C's for the coefficient of variation of t_{\max} are given in figure A4. The values in figure A4 are negative because t_{\max} is less variable during the summer when the mean t_{\max} is greatest. The values of \bar{u} and C for the coefficients of variation of t_{\max} were the same for either wet or dry days.

The \bar{u} values for the mean of t_{\max} on wet days was significantly less than for dry days and are mapped in figure A5. Maps of the other parameters for t_{\max} on wet days were not required since they were not significantly different from the parameters for t_{\max} on dry days.

The maps of \bar{u} and C for the means and coefficients of variation of t_{\min} are shown in figures A6-A9. All these parameters had a strong regional pattern.

The map of \bar{u} for the mean of r on dry days is given in figure A10. Similar to t_{\max} , C for the mean of r was not significantly different on wet or dry days. The map of C for the mean of r (wet or dry) is given in figure A11. The map of \bar{u} for the mean of r on wet days is given in figure A12.

The values of \bar{u} and C for the coefficients of variation of r given in table 5 showed no relationship to station location. The variation in each of the four parameters among the 31 locations was assumed to be sampling error. In WGEN the value of the four parameters are assumed to be constant at the average values given in table 5.

Precipitation and Temperature Correction

For most locations, the data generated with these procedures will have mean monthly precipitation and temperatures that are very close to the means obtained from actual data. In some cases, there will be differences caused by the temporal and spatial smoothing that is inherent in the model or topographic features of the location or other factors. Procedures have been developed that provide for the correction of these differences if actual mean monthly values are available and the user chooses to make these corrections. Use of the correction options provides generated daily values that compare very closely with the monthly means derived from the actual observations. Use of the correction procedure requires that the actual monthly means for the variable to be corrected be input to the generation program. Mean monthly precipitation and/or temperatures for selected locations are available from many sources, such as the Climatic Atlas of the United States (U.S. Department of Commerce, 1968).

The precipitation correction factor for a given month is calculated as the mean monthly precipitation from actual data divided by the mean monthly precipitation theoretically generated with the Markov chain-gamma model. The generated daily precipitation amounts are multiplied by the precipitation correction factor for the appropriate month to obtain a corrected precipitation amount.

The temperature correction may be based on either the actual mean monthly temperature or mean maximum temperature and mean minimum temperature, depending on which type of data are available for the location. For the actual mean monthly temperature, the temperature correction factor is calculated as the difference between the actual mean monthly temperature for the location and the mean monthly temperature theoretically generated using the parameters for the location. The generated daily maximum and minimum temperatures are both corrected by adding the correction factor to the generated temperatures. When mean monthly maximum and minimum temperatures are available, correction factors for maximum temperature and minimum temperature are computed independently.

The WGEN Program

The WGEN program can be used to generate daily values of precipitation, maximum temperature, minimum temperature, and solar radiation. The inputs required for WGEN, input formats, and the source of each input is given in appendix B. The Fortran program of WGEN is given in appendix C. The program contains two major options. If option 1 is chosen, the program will generate daily values of p (inches), t_{\max} ($^{\circ}\text{F}$), t_{\min} ($^{\circ}\text{F}$), and r (ly) for the number of years specified by the user. If option 2 is chosen, the program will read actual precipitation supplied by the user and generate corresponding values of t_{\max} , t_{\min} , and r . Option 2 is provided because frequently a user will have a long record of actual precipitation data with corresponding data for daily temperature or solar radiation.

Options are also provided that enable the user to correct generated precipitation and temperature based on actual data. The user may choose to (1) make no corrections, (2) correct both precipitation and temperature, (3) correct only precipitation, or (4) correct only temperature. The codes that are required for the various options are given in the list of inputs in appendix B.

The WGEN program will print daily values of the four variables. A summary of the monthly and annual amounts will be printed at the end of each year. At the end of the n -year run, the mean monthly and mean annual amounts will be printed.

The WGEN PAR Program

To generate weather data for a location outside the 48 contiguous states, or to develop generation parameters for actual data from a specific location, the WGEN PAR program given in appendix D may be used. The WGEN PAR program reads daily values of p , t_{\max} , t_{\min} , and r and writes the generation parameters that are required by WGEN. The number of years of weather data required to develop parameters representative of a particular location vary with the climate. In general, at least 20 years of precipitation and 10 years of temperature and radiation are required. Longer records of precipitation may be required for arid locations.

RESULTS AND DISCUSSION

The WGEN model has been subjected to extensive testing. The results will be illustrated by applying the model at five locations with a wide variety of climates and comparing the results with recorded data. The locations are Columbia, MO; Boise, ID; Miami, FL; Phoenix, AZ; and Boston, MA. The rainfall parameters were obtained from table A1, and the temperature and solar radiation parameters were obtained from figures A1-A12 for each location. A 30-year sample of weather data was generated for each location without correcting precipitation and temperature based on actual monthly means.

Several statistics were selected in comparing the generated weather data with observed data. The following statistics were compared for each month and for the year:

- 1) Mean precipitation amount.
- 2) Mean number of wet days ($p \geq 0.01$ inches).
- 3) Mean run of wet days (maximum length of consecutive wet days).
- 4) Mean number of days with $p > 2.0$ inches.
- 5) Mean daily solar radiation.
- 6) Mean daily maximum temperature.
- 7) Mean daily minimum temperature.
- 8) Mean monthly and annual maximum temperature.
- 9) Mean monthly and annual minimum temperature.
- 10) Mean number of days with $t_{\max} > 95^{\circ}\text{F}$.
- 11) Mean number of days with $t_{\min} < 32^{\circ}\text{F}$.

The results of the comparisons are given in tables 7-11.

The Markov chain-gamma model that was used for generating daily precipitation amounts gave results that compared well with the observed data. The precipitation amounts and the seasonal distribution of precipitation were accurately represented in the generated data. No significant differences occurred between the observed and generated mean monthly or annual precipitation amounts for any of the five locations. The mean number of wet

days per month was also accurately simulated at all five locations. The persistence of wet days as indicated by the maximum length of consecutive wet days for each month and the frequency of occurrence of daily precipitation in excess of 2.0 inches also compared favorably with the observed data.

The mean daily solar radiation generated with WGEN was not significantly different from the observed data for any month at any of the five locations.

The daily maximum and minimum temperature generation procedure also produced results that are good representations of the observed data. Mean daily maximum and mean daily minimum temperatures by month were significantly different in only 20 of the 130 cases. In most instances, the differences were due to the actual data not having a simple sinusoidal shape as assumed in the model (fig. 3). This problem can be corrected by use of the local average temperature correction previously described.

The statistics that reflect temperature extremes did not compare as well with the observed data as did the other statistics. This result could be expected because the extremes are not as directly related to the generation procedure as mean monthly temperatures. In general, however, the temperature extremes are adequate for most applications.

The precipitation and temperature correction procedures offer an opportunity to make adjustments in the generation procedure when the parameters from table A1 and figures A1-A9 are not adequate due to some physical effect (such as topography), or when a more precise definition of precipitation and/or temperature is needed. As an example of the application of the correction procedure, a 30-year record of weather data was generated for a site on Reynolds Mountain,^{3/} south of Boise, ID. Boise was the nearest location for which precipitation parameters could be obtained from table A1. The elevation at the Reynolds Mountain site is 7,100 feet while the elevation at Boise is only 2,840 feet. The precipitation regime on Reynolds Mountain is considerably different from that in Boise because of the elevation difference and related factors. Similarly, actual temperatures at the Reynolds Mountain site are much lower than would be generated using the parameters from figures A1-A9 since the parameters were developed for sites at lower elevations such as Boise. To adjust these differences, the precipitation and temperature correction options were used. The mean monthly precipitation, maximum temperature, and minimum temperature were calculated from actual data from Reynolds Mountain. These means were input to the WGEN program along with the generation parameters obtained from table A1 and figures A1-A12 for Boise.

^{3/} The weather data for Reynolds Mountain were obtained by the USDA-ARS Northwest Watershed Research Center and supplied by C. L. Hanson.

The results of the generation are shown in table 12. The mean monthly precipitation amounts from the generated data are an excellent representation of the observed data. However, the wet days generated by WGEN are less than the observed number because only the rainfall amounts are changed with the correction procedure. The daily maximum and minimum temperatures generated using the correction procedure also compare closely with the observed data for Reynolds Mountain and are much lower than would be generated without the correction procedure (see table 8).

SUMMARY

The WGEN model is designed for use in generating daily values of precipitation, maximum temperature, minimum temperature, and solar radiation that are representative of the weather at a specific site. The generation procedure is designed to account for the dependence structure of the four variables. The serial dependence of p is described using a first-order Markov chain. The t_{\max} , t_{\min} , and r values are related to p by conditioning the values on the wet or dry status of the day. The persistence of t_{\max} , t_{\min} , and r is preserved using the serial-correlation of each variable. The dependence among the three variables is preserved using the cross-correlation coefficients. The generation procedure is also designed to describe the seasonal characteristics of the variables. The basic structure of the model is simple and several assumptions are made to enable general application of the model.

Two major generation options are available with WGEN. The user may choose to (1) generate daily values of all four variables or (2) use actual precipitation data and generate the other three variables. In addition to the two major options, the user may choose to apply correction factors to precipitation and/or temperature based on actual mean monthly values.

A Fortran program of WGEN is given in appendix C. Application of WGEN to a particular site requires that 48 precipitation parameters and 12 temperature and radiation parameters be defined. The precipitation parameters have been defined for 139 locations in the United States and are given in table A1. The temperature and radiation parameters have been mapped and are given in figures A1-A12. A description of the input format for WGEN is given in appendix B. A Fortran program is given in appendix D that can be used to define the generation parameters derived from actual weather data for a particular site.

LITERATURE CITED

- Bond, D. C. 1979. Generating daily weather values by computer simulation techniques for crop yield forecasting models. USDA-SRS (formerly USDA-ESCS), Statis. Res. Div., 38 pp. Washington, D.C.
- Bruhn, J. A., W. E. Fry, and G. W. Fick. 1980. Simulation of daily weather data using theoretical probability distributions. J. Appl. Meteor. 19(9):1029-1036.
- Haan, C. T. 1977. Statistical Methods in Hydrology, 378 pp. The Iowa State Univ. Press, Ames.
- Jones, J. W., R. F. Colwick, and E. D. Threadgill. 1972. A simulated environmental model of temperature, evaporation, rainfall, and soil moisture. Trans. ASAE 15(2):366-372.
- Larsen, G. A. and R. B. Pense. 1981. Stochastic simulation of daily climatic data. USDA-SRS, Statis. Res. Div. Rpt. No. AGES810831. Washington, D.C.
- Matalas, N. C. 1967. Mathematical assessment of synthetic hydrology. Water Resources Res. 3(4):937, 945.
- Nicks, A. D. and J. F. Harp. 1980. Stochastic generation of temperature and solar radiation data. J. Hydrology 48:1-17.
- Richardson, C. W. 1981. Stochastic simulation of daily precipitation, temperature, and solar radiation. Water Resources Res. 17(1):182-190.
- Richardson, C. W. 1982a. A comparison of three distributions for the generation of daily rainfall amounts. In Singh, V. P. (ed.), Statistical Analysis of Rainfall and Runoff, pp. 67-78, Proc. Int. Symp. on Rainfall-Runoff Modeling, Water Resources Publications, 700 pp.
- Richardson, C. W. 1982b. Dependence structure of daily temperature and solar radiation. Trans. ASAE 25(3):735-739.
- Smith, R. E. and H. A. Schreiber. 1974. Point processes of seasonal thunderstorm rainfall. 2. Rainfall depth probabilities. Water Resources Res. 10(3):418-423.
- U.S. Department of Commerce. 1968. Climatic atlas of the United States. Environ. Sci. Serv. Admin., Environ. Data Serv., 80 pp.
- Woolhiser, D. A. and J. Roldan. 1982. Stochastic daily precipitation models. 2. A comparison of distributions of amounts. Water Resources Res. 18(5):1461-1468.

Table 1. Values of \bar{u} , C, and T for the mean maximum temperature on wet or dry days for 31 locations in the United States

Location	Dry days			Wet days		
	\bar{u} (°F)	C (°F)	T (days)	\bar{u} (°F)	C (°F)	T (days)
Albuquerque, NM	71.0	23.1	195.9	64.8	24.4	200.6
Atlanta, GA	71.8	19.3	197.1	69.8	17.2	197.1
Bismarck, ND	55.5	32.4	201.7	48.8	32.1	199.4
Boise, ID	63.7	26.1	198.3	59.4	20.6	202.9
Boston, MA	59.3	24.0	202.9	58.2	20.7	209.2
Brownsville, TX	83.4	10.8	201.1	78.4	13.1	204.6
Caribou, ME	48.6	30.1	201.1	48.4	23.9	204.6
Charleston, SC	75.6	15.9	197.1	74.4	14.6	201.1
Cleveland, OH	60.0	25.3	203.5	58.6	25.1	201.1
Columbia, MO	66.0	25.5	200.6	64.0	23.8	201.1
Dodge City, KS	69.5	24.4	199.4	59.5	28.7	198.3
El Paso, TX	78.1	19.5	194.8	71.5	22.0	197.1
Ely, NV	62.5	23.5	203.5	54.5	23.1	206.3
Fresno, CA	76.7	21.0	200.6	69.4	16.8	208.1
Great Falls, MT	59.5	24.1	202.3	46.9	28.4	198.8
Grand Junction, CO	66.6	27.7	197.7	59.9	24.7	200.6
Greensboro, NC	69.8	20.5	197.7	67.6	19.2	196.5
Indianapolis, IN	62.3	26.4	200.0	62.0	23.5	200.6
Lander, WY	60.0	26.3	200.6	49.7	25.1	200.6
Little Rock, AR	73.7	21.8	198.3	70.6	19.9	199.4
Madison, WI	57.0	29.1	200.0	55.9	27.5	201.7
Medford, OR	68.3	22.6	198.3	60.9	16.3	203.5
Miami, FL	83.1	7.9	204.0	82.6	6.4	207.5
Nashville, TN	70.3	23.2	198.8	69.6	19.7	198.8
Oklahoma City, OK	72.6	22.4	199.4	66.1	24.1	200.0
Phoenix, AZ	85.5	19.8	200.6	76.8	20.7	205.8
Rapid City, SD	62.4	25.7	202.9	51.7	29.0	200.0
Salt Lake City, UT	65.3	27.3	199.4	59.6	23.5	204.6
San Antonio, TX	81.0	16.5	198.3	75.8	16.8	198.3
Sault Ste. Marie, MI	49.9	27.7	204.0	47.9	25.5	204.0
Spokane, WA	58.4	26.3	197.7	53.6	20.3	198.8
Mean	67.3	23.1	199.9	62.5	21.8	201.6
Std. dev.	9.5	5.2	2.4	9.8	5.3	3.4

Table 2. Values of \bar{u} , C, and T for coefficient of variation of maximum temperature on wet or dry days for 31 locations in the United States

Location	Dry days			Wet days		
	\bar{u}	C	T (days)	\bar{u}	C	T (days)
Albuquerque	0.11	-0.07	201.1	0.14	-0.07	201.1
Atlanta	0.12	-0.08	201.7	0.12	-0.06	198.8
Bismarck	0.30	-0.28	200.6	0.32	-0.28	197.7
Boise	0.15	-0.07	201.7	0.15	-0.03	194.2
Boston	0.16	-0.08	205.2	0.16	-0.06	215.6
Brownsville	0.07	-0.05	194.2	0.09	-0.06	193.1
Caribou	0.26	-0.23	200.6	0.21	-0.12	197.1
Charleston	0.10	-0.07	200.6	0.10	-0.06	205.8
Cleveland	0.22	-0.07	209.8	0.21	-0.13	205.8
Columbia	0.19	-0.13	200.6	0.19	-0.13	201.1
Dodge City	0.17	-0.11	204.0	0.23	-0.15	202.9
El Paso	0.09	-0.05	198.8	0.13	-0.07	202.3
Ely	0.15	-0.10	203.5	0.17	-0.06	198.3
Fresno	0.10	-0.03	204.6	0.10	-0.01	199.4
Great Falls	0.21	-0.14	201.7	0.40	-0.36	195.9
Grand Junction	0.14	-0.09	200.6	0.15	-0.06	195.4
Greensboro	0.13	-0.08	202.9	0.15	-0.07	202.3
Indianapolis	0.19	-0.14	200.6	0.18	-0.12	203.5
Lander	0.19	-0.14	195.9	0.25	-0.15	191.3
Little Rock	0.13	-0.09	199.4	0.14	-0.09	197.1
Madison	0.22	-0.17	199.4	0.21	-0.13	202.9
Medford	0.13	-0.04	202.3	0.13	-0.01	204.0
Miami	0.05	-0.03	204.0	0.05	-0.02	222.5
Nashville	0.15	-0.11	200.0	0.14	-0.08	200.0
Oklahoma City	0.15	-0.10	201.1	0.18	-0.12	198.3
Phoenix	0.08	-0.03	212.7	0.09	-0.02	194.2
Rapid City	0.22	-0.15	201.1	0.30	-0.22	197.7
Salt Lake City	0.15	-0.09	201.1	0.17	-0.07	197.1
San Antonio	0.09	-0.06	198.8	0.12	-0.07	197.7
Sault Ste. Marie	0.24	-0.18	204.6	0.22	-0.13	205.8
Spokane	0.16	-0.08	194.8	0.16	-0.05	195.4
Ave.	0.16	-0.10	201.5	0.17	-0.10	200.5
Std. dev.	0.06	.06	3.7	0.07	0.08	6.3

Table 3. Values of \bar{u} , C, and T for the mean and coefficient of variation of minimum temperature for 31 locations in the United States

Location	Mean wet or dry days			Coef. of var. wet or dry days		
	\bar{u} (°F)	C (°F)	T (days)	\bar{u}	C	T (days)
Albuquerque	43.5	21.0	200.6	0.17	-0.13	202.9
Atlanta	51.4	18.8	199.4	0.16	-0.13	198.3
Bismarck	29.3	28.7	199.4	0.65	-0.90	200.0
Boise	39.5	17.1	201.7	0.22	-0.06	187.9
Boston	43.6	21.0	207.5	0.20	-0.18	199.4
Brownsville	64.9	12.7	197.7	0.11	-0.08	196.5
Caribou	29.8	25.1	205.2	0.35	-0.50	207.5
Charleston	53.9	18.2	199.4	0.16	-0.12	195.9
Cleveland	41.3	21.3	205.2	0.29	-0.16	203.5
Columbia	44.7	23.3	200.6	0.26	-0.22	198.8
Dodge City	42.9	24.2	201.1	0.25	-0.20	201.7
El Paso	50.8	20.2	197.1	0.15	-0.11	199.4
Ely	28.1	18.2	200.6	0.45	-0.45	194.2
Fresno	48.7	13.3	201.7	0.12	-0.05	195.4
Great Falls	34.1	20.6	204.0	0.49	-0.56	199.4
Grand Junction	40.3	22.7	199.4	0.23	-0.20	196.5
Greensboro	47.0	20.2	199.4	0.20	-0.14	196.5
Indianapolis	42.3	22.6	200.0	0.28	-0.24	199.4
Lander	31.7	22.5	200.6	0.44	-0.48	195.9
Little Rock	51.4	20.5	197.1	0.18	-0.13	195.9
Madison	35.1	24.6	202.3	0.48	-0.55	200.6
Medford	40.6	11.7	204.0	0.16	-0.06	191.3
Miami	68.2	9.1	206.3	0.08	-0.06	204.0
Nashville	48.5	20.8	198.3	0.22	-0.17	198.8
Oklahoma City	49.0	22.3	199.4	0.19	-0.15	200.0
Phoenix	56.5	19.5	204.6	0.11	-0.05	202.3
Rapid City	34.5	23.8	202.3	0.42	-0.46	200.0
Salt Lake City	38.9	19.8	200.6	0.25	-0.18	194.2
San Antonio	58.0	17.7	197.7	0.15	-0.11	200.0
Sault Ste.Marie	31.1	23.3	209.8	0.61	-0.80	208.7
Spokane	37.4	16.2	201.1	0.23	-0.16	194.2
Ave.	43.8	20.0	201.4	0.27	-0.25	198.7
Std. dev.	10.1	4.2	3.1	0.15	0.22	4.3

Table 4. Values of \bar{u} , C, and T for the mean solar radiation on wet or dry days for 31 locations in the United States

Location	Dry days			Wet days		
	\bar{u} (ly)	C (ly)	T (days)	\bar{u} (ly)	C (ly)	T (days)
Albuquerque	520.4	224.6	171.1	285.2	226.7	180.9
Atlanta	448.1	174.0	166.5	259.4	161.7	177.4
Bismarck	401.0	266.1	171.7	271.1	181.2	174.0
Boise	429.2	276.0	173.4	282.7	209.3	179.2
Boston	388.0	218.5	168.2	201.9	142.5	176.9
Brownsville	480.5	175.1	180.9	291.4	157.1	191.9
Caribou	383.2	245.6	164.7	224.6	142.2	166.5
Charleston	462.7	176.2	165.3	283.0	159.2	176.3
Cleveland	383.6	244.4	171.1	244.0	176.7	175.1
Columbia	430.8	226.7	174.6	258.7	185.7	178.6
Dodge City	464.2	221.0	172.8	308.6	198.4	174.6
El Paso	545.3	206.7	168.2	419.8	227.7	172.2
Ely	486.4	241.5	172.2	341.4	174.6	171.7
Fresno	462.1	259.4	172.8	292.9	175.6	170.5
Great Falls	389.9	277.2	172.8	271.6	176.5	169.9
Grand Junction	478.7	235.8	172.8	329.5	183.1	175.7
Greensboro	434.4	184.2	168.2	263.2	170.8	172.2
Indianapolis	407.1	224.5	172.8	248.7	179.5	176.9
Lander	451.8	242.3	169.9	324.1	162.1	164.7
Little Rock	438.1	195.7	169.9	254.0	174.3	179.8
Madison	398.8	240.6	169.9	245.8	170.2	175.1
Medford	425.9	298.6	174.6	271.9	192.0	174.0
Miami	494.2	135.7	167.0	367.9	108.0	180.3
Nashville	431.0	207.8	170.5	255.3	186.2	179.8
Oklahoma City	449.3	194.3	174.6	270.1	180.6	178.6
Phoenix	516.0	208.9	165.9	360.7	195.7	180.3
Rapid City	414.0	238.4	171.1	293.8	173.7	168.8
Salt Lake City	462.8	267.2	172.2	309.1	200.1	176.9
San Antonio	466.5	168.9	181.5	292.0	166.7	183.8
Sault Ste. Marie	396.5	277.8	165.3	230.6	144.2	167.0
Spokane	394.3	296.7	172.8	255.1	200.8	171.1
Ave.	443.1	227.4	171.1	284.1	176.9	175.5
Std. dev.	43.0	40.0	4.0	45.5	24.5	5.5

Table 5. Values of \bar{u} , C, and T for the coefficient by variation of solar radiation on wet or dry days for 31 locations in the United States

Location	Dry days			Wet days		
	\bar{u}	C	T (days)	\bar{u}	C	T (days)
Albuquerque	0.15	-0.05	190.7	0.32	-0.13	178.6
Atlanta	0.24	-0.06	197.7	0.56	-0.22	194.8
Bismarck	0.26	-0.07	190.2	0.46	-0.01	197.7
Boise	0.23	-0.12	189.6	0.44	-0.12	178.0
Boston	0.28	-0.05	182.1	0.70	-0.16	186.1
Brownsville	0.24	-0.11	204.0	0.52	-0.19	211.5
Caribou	0.28	-0.06	117.9	0.55	-0.08	90.2
Charleston	0.22	-0.06	190.2	0.52	-0.17	197.1
Cleveland	0.32	-0.12	180.3	0.56	-0.16	179.8
Columbia	0.28	-0.11	200.0	0.59	-0.22	189.6
Dodge City	0.23	-0.06	202.3	0.52	-0.13	181.5
El Paso	0.14	-0.04	175.1	0.33	-0.13	172.2
Ely	0.17	-0.04	197.7	0.33	-0.07	160.7
Fresno	0.21	-0.15	186.7	0.48	-0.12	156.1
Great Falls	0.26	-0.08	179.8	0.43	-0.04	111.6
Grand Junction	0.19	-0.04	205.2	0.38	-0.10	176.3
Greensboro	0.24	-0.05	193.1	0.55	-0.19	187.3
Indianapolis	0.29	-0.12	197.1	0.58	-0.23	183.8
Lander	0.18	-0.01	178.6	0.38	-0.02	118.5
Little Rock	0.26	-0.10	192.5	0.57	-0.24	196.5
Madison	0.30	-0.08	176.9	0.59	-0.13	179.2
Medford	0.26	-0.16	184.4	0.42	-0.10	163.6
Miami	0.19	-0.02	194.8	0.35	-0.05	222.0
Nashville	0.28	-0.12	192.5	0.56	-0.25	191.3
Oklahoma City	0.26	-0.07	200.6	0.58	-0.20	189.0
Phoenix	0.14	-0.04	169.9	0.40	-0.16	192.5
Rapid City	0.23	-0.04	192.5	0.43	-0.04	131.2
Salt Lake City	0.22	-0.10	184.4	0.42	-0.12	169.4
San Antonio	0.25	-0.12	210.4	0.53	-0.23	205.2
Sault Ste. Marie	0.29	-0.11	150.3	0.54	-0.04	111.5
Spokane	0.28	-0.14	178.0	0.44	-0.09	154.9
Ave.	0.24	-0.08	186.6	0.48	-0.13	172.8
Std. dev.	0.05	0.04	17.6	0.09	0.07	31.1

Table 6. Variable names for the means (\bar{u}) and amplitudes (C) of equation (14) for t_{\max} , t_{\min} , and r

Variable name	Description
TXMD	mean of t_{\max} (dry), °F
ATX	amplitude of t_{\max} (wet or dry), °F
CVTX	mean coef. of var. of t_{\max} (wet or dry)
ACVTX	amplitude of coef. of var. of t_{\max} (wet or dry)
TXMW	mean of t_{\max} (wet), °F
TN	mean of t_{\min} (wet or dry), °F
ATN	amplitude of t_{\min} (wet or dry), °F
CVTN	mean of coef. of var. of t_{\min} (wet or dry)
ACVTN	amplitude of coef. of var. of t_{\min} (wet or dry)
RMD	mean of r (dry), ly
AR	amplitude of r (dry), ly
CVRD	mean of coef. of var. of r (dry) (assumed to be 0.24 for all locations)
ACVRD	amplitude of coef. of var. of r (dry) (assumed to be -0.08 for all locations)
RMW	mean of r (wet), ly
CVRW	mean of coef. of var. of r (wet) (assumed to be 0.48 for all locations)
ACVRW	amplitude of coef. of var. of r (wet) (assumed to be -0.13 for all locations)

TABLE 7. COMPARISON OF GENERATED AND OBSERVED WEATHER DATA, COLUMBIA, MO.

PRECIPITATION AMOUNT (IN)		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
OBSERVED	MEAN	1.41	1.68	2.51	3.63	4.45	4.15	3.95	2.84	4.00	3.12	1.58	1.66	34.98
GENERATED	MEAN	1.27	1.68	2.97	3.40	4.12	4.79	4.43	3.14	3.94	3.36	1.73	1.86	36.69
NO. OF WET DAYS														
OBSERVED	MEAN	7.15	7.60	10.40	11.40	10.50	10.30	9.25	7.55	7.95	7.55	6.20	8.25	104.10
GENERATED	MEAN	6.10	7.27	10.80	11.03	10.60	10.87	9.40	7.03	7.27	7.07	6.10	8.57	102.10
RUN OF WET DAYS														
OBSERVED	MEAN	2.65	2.90	3.50	3.70	3.85	3.80	3.30	2.55	3.15	2.85	2.80	2.85	5.70
GENERATED	MEAN	2.37	2.80	3.63	3.77	3.90	3.93	3.47	2.53	2.93	2.83	2.47	3.37	6.23
NO. DAYS > 2.0 IN														
OBSERVED	MEAN	0.00	0.00	0.05	0.10	0.10	0.25	0.15	0.20	0.40	0.15	0.00	0.05	1.45
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.17	0.27	0.27	0.23	0.30	0.17	0.00	0.00	1.40
RADIATION MEAN DAILY (LY)														
OBSERVED	MEAN	185.6	261.3	348.0	440.1	531.4	570.6	583.7	522.8	427.3	322.2	212.0	160.6	381.1
GENERATED	MEAN	192.9	257.7	342.6	452.2	541.4	581.3	577.8	515.9	403.2	286.8	206.9	162.9	377.4

TABLE 7. CONTINUED.

TEMPERATURE		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
DAILY MAXIMUM (F)														
OBSERVED	MEAN	38.24	43.24	51.57	66.15	75.71	83.99	88.77	87.48	80.46	69.28	54.13	42.02	65.18
GENERATED	MEAN	39.46	42.04	49.90	63.94	75.17	86.77	89.80	87.06	78.12	65.80	52.90	44.00	64.70
DAILY MINIMUM (F)														
OBSERVED	MEAN	19.73	24.25	31.42	44.59	54.40	63.32	67.51	65.65	57.49	46.77	34.20	24.88	44.60
GENERATED	MEAN	20.77	22.49	30.35	43.75	54.30	63.91	67.18	64.62	56.20	44.62	32.89	24.79	43.94
MONTHLY/ANNUAL MAX (F)														
OBSERVED	MEAN	65.16	65.32	77.46	86.26	89.19	94.05	98.40	97.32	93.25	86.34	74.10	66.64	100.04
GENERATED	MEAN	60.97*	63.47	73.50	86.67	93.03*	98.97*	98.27	98.63	94.60	88.10	74.00	66.33	101.93
MONTHLY/ANNUAL MIN (F)														
OBSERVED	MEAN	-2.69	4.66	12.39	29.00	37.91	50.30	56.05	52.96	41.58	30.41	15.49	4.90	-5.14
GENERATED	MEAN	-0.40	0.30*	7.37*	21.13*	37.17	57.60*	64.77*	59.13*	42.73	24.07*	7.13*	2.80	-6.83
ND. DAYS > 95 F														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	1.95	5.35	4.75	1.50	0.00	0.00	0.00	13.55
GENERATED	MEAN	0.00	0.00	0.00	0.10	0.90*	3.83*	4.83	3.77	0.87	0.10	0.00	0.00	14.40
ND. DAYS < 32 F														
OBSERVED	MEAN	27.10	21.65	17.45	3.10	0.00	0.00	0.00	0.00	0.00	1.95	13.10	23.70	108.05
GENERATED	MEAN	25.80	22.77	17.63	5.53*	0.30	0.00	0.00	0.00	0.10	4.20*	14.30	23.30	113.93*

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 8. COMPARISON OF GENERATED AND OBSERVED WEATHER DATA, BOISE, ID.

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
PRECIPITATION														
AMOUNT (IN)														
OBSERVED	MEAN	1.69	1.05	0.91	1.20	1.31	1.01	0.19	0.39	0.45	0.71	1.29	1.30	11.52
GENERATED	MEAN	1.62	1.28	0.96	1.16	1.36	0.88	0.20	0.53	0.33	0.65	1.32	1.32	11.62
NO. OF WET DAYS														
OBSERVED	MEAN	13.50	9.90	9.05	7.90	8.40	6.70	2.05	2.75	3.55	6.20	9.25	11.55	90.80
GENERATED	MEAN	11.87	11.70	8.80	7.77	8.40	6.07	1.73	3.10	2.97	5.90	8.70	11.97	88.97
RUN OF WET DAYS														
OBSERVED	MEAN	6.00	4.70	3.45	3.00	3.40	3.00	1.45	1.90	2.25	2.40	4.35	4.10	7.80
GENERATED	MEAN	4.50*	4.60	3.37	2.87	3.27	2.57	1.20	1.93	1.83	2.77	3.73	4.73	6.73
NO. DAYS > 2.0 IN														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RADIATION														
MEAN DAILY (LY)														
OBSERVED	MEAN	141.0	231.2	350.8	485.0	588.8	634.0	672.5	579.1	457.6	308.6	172.7	124.3	400.4
GENERATED	MEAN	119.0	197.4	350.5	499.2	594.9	662.9	660.3	550.5	418.6	265.2	147.6	99.1	381.4

TABLE 8. CONTINUED.

TEMPERATURE		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
DAILY MAXIMUM (F)														
OBSERVED	MEAN	37.73	44.02	51.56	60.81	70.79	79.26	90.84	87.55	77.73	64.51	49.19	39.17	62.87
GENERATED	MEAN	33.06	36.22*	45.58*	58.98	72.24	82.79	86.94	83.90	75.32	61.78	47.64	38.33	60.36
DAILY MINIMUM (F)														
OBSERVED	MEAN	23.12	27.33	30.35	35.94	44.00	51.83	58.73	56.84	48.83	39.02	30.50	24.86	39.35
GENERATED	MEAN	21.75	24.47	29.62	37.48	46.37	52.89	54.95*	53.72	48.20	39.30	30.91	25.71	38.86
MONTHLY/ANNUAL MAX (F)														
OBSERVED	MEAN	52.05	57.60	68.25	77.95	88.85	96.95	102.00	100.80	92.70	81.80	64.45	54.55	103.85
GENERATED	MEAN	48.20*	51.47*	62.73*	78.97	89.43	95.83	99.13*	98.03*	93.10	80.77	65.73	54.57	101.33
MONTHLY/ANNUAL MIN (F)														
OBSERVED	MEAN	4.30	14.30	18.10	24.10	30.70	39.35	46.40	44.60	34.55	25.95	16.90	9.95	1.35
GENERATED	MEAN	6.37	10.07*	12.67*	19.93*	32.23	42.40*	46.10	42.50*	33.63	23.60	14.20	10.40	3.43
NO. DAYS > 95 F														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.10	2.15	9.65	6.20	0.65	0.00	0.00	0.00	18.75
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.13	1.60	4.13*	2.47*	0.77	0.00	0.00	0.00	9.10*
NO. DAYS < 32 F														
OBSERVED	MEAN	25.35	21.20	19.95	9.50	1.90	0.00	0.00	0.00	0.60	5.70	17.50	26.30	128.00
GENERATED	MEAN	28.63*	23.67*	19.27	8.80	1.23	0.03	0.00	0.00	0.77	6.37	16.67	23.83	129.27

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 9. COMPARISON OF GENERATED AND OBSERVED WEATHER DATA, MIAMI, FL.

PRECIPITATION AMOUNT (IN)		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
OBSERVED	MEAN	2.27	2.20	2.05	2.65	6.49	9.84	6.21	6.61	8.62	8.37	2.63	1.69	59.65
GENERATED	MEAN	2.22	2.39	2.09	2.12	7.68	10.02	6.45	6.18	8.70	8.65	2.40	1.54	60.45
NO. OF WET DAYS														
OBSERVED	MEAN	6.60	6.00	6.05	5.90	9.90	15.85	15.70	15.85	17.10	14.85	7.05	5.65	126.50
GENERATED	MEAN	6.27	6.30	5.50	5.30	10.40	15.33	14.93	14.70	15.00	12.97	6.63	5.07	118.40
RUN OF WET DAYS														
OBSERVED	MEAN	2.40	2.30	2.55	2.20	5.35	6.45	5.75	5.95	7.85	6.00	2.75	2.35	10.25
GENERATED	MEAN	2.37	2.53	2.07	2.63	4.87	5.53	5.47	5.10	6.10	5.03	2.63	1.97	8.47
NO. DAYS > 2.0 IN														
OBSERVED	MEAN	0.05	0.15	0.10	0.10	0.85	1.05	0.35	0.40	0.70	1.15	0.25	0.10	5.25
GENERATED	MEAN	0.07	0.03	0.03	0.13	1.00	1.13	0.37	0.23	0.70	1.00	0.07	0.03	4.80
RADIATION														
MEAN DAILY (LY)														
OBSERVED	MEAN	332.2	409.3	479.8	546.9	548.9	516.3	544.1	517.2	442.3	394.5	355.1	323.3	452.2
GENERATED	MEAN	332.4	384.3	449.4	522.6	554.4	565.2	543.1	498.6	435.6	373.3	333.4	314.3	442.4

TABLE 9. CONTINUED.

TEMPERATURE		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
DAILY MAXIMUM (F)														
OBSERVED	MEAN	74.86	76.20	79.12	82.50	85.17	87.54	88.97	89.94	88.13	84.38	79.71	75.96	82.74
GENERATED	MEAN	73.83	75.32	78.07	82.04	86.58	90.00*	91.33*	90.43	86.92	82.56	79.45	75.33	82.69
DAILY MINIMUM (F)														
OBSERVED	MEAN	58.37	59.69	63.24	67.83	71.32	74.14	75.87	76.15	75.36	71.21	64.68	59.66	68.17
GENERATED	MEAN	55.12*	56.73	60.31	65.17*	70.86	75.12	76.85*	75.65	71.38*	66.32*	61.95	57.04	66.09
MONTHLY/ANNUAL MAX (F)														
OBSERVED	MEAN	82.75	85.10	87.30	89.80	90.40	92.30	92.85	93.65	92.00	89.15	85.35	82.95	94.60
GENERATED	MEAN	87.53*	89.10*	90.03*	91.10	92.37*	93.40*	93.43	93.53	92.80	91.57*	90.77*	88.80*	95.63
MONTHLY/ANNUAL MIN (F)														
OBSERVED	MEAN	40.00	44.70	46.70	56.70	62.65	69.40	71.90	72.30	71.50	61.25	49.75	42.75	37.90
GENERATED	MEAN	42.80*	43.23	48.13	55.87	63.77	70.73*	74.57*	71.57*	64.90*	57.97*	50.77	43.67	40.03*
NO. DAYS > 95 F														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	0.05	0.20	1.10	0.05	0.00	0.00	0.00	1.40
GENERATED	MEAN	0.03	0.07	0.13	0.13	0.03	0.13	0.03	0.03*	0.17	0.17	0.37	0.03	1.33
NO. DAYS < 32 F														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 10. COMPARISON OF GENERATED AND OBSERVED WEATHER DATA, PHOENIX, AZ.

PRECIPITATION AMOUNT (IN)		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
OBSERVED	MEAN	0.73	0.53	0.76	0.30	0.10	0.15	0.73	1.20	0.68	0.51	0.49	0.85	7.03
GENERATED	MEAN	0.62	0.50	0.91	0.23	0.07	0.10	0.72	1.20	1.10	0.46	0.40	0.84	7.15
NO. OF WET DAYS														
OBSERVED	MEAN	3.95	3.45	3.15	1.70	0.80	0.90	4.15	5.50	2.75	2.40	2.45	3.55	34.75
GENERATED	MEAN	2.80	3.53	3.53	1.67	0.57	0.60	4.00	5.43	3.70	2.30	2.33	3.13	33.60
RUN OF WET DAYS														
OBSERVED	MEAN	2.20	2.45	1.85	1.40	1.25	1.25	2.10	2.30	2.05	1.75	1.60	2.10	4.15
GENERATED	MEAN	1.87	2.13	2.07	1.33	1.17	1.17	2.13	2.13	2.17	1.73	1.67	1.80	3.93
NO. DAYS > 2.0 IN														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.10
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.07
RADIATION														
MEAN DAILY (LY)														
OBSERVED	MEAN	296.9	399.8	507.4	636.9	708.6	722.8	641.2	591.3	530.5	438.9	325.9	268.2	501.0
GENERATED	MEAN	289.9	361.8	471.9	587.7	665.8	703.0	665.6	581.4	490.0	392.8	313.7	268.9	483.3

TABLE 10. CONTINUED.

TEMPERATURE		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	DCT.	NDV.	DEC.	ANN.
DAILY MAXIMUM (F)														
DBSERVED	MEAN	64.91	68.84	74.05	82.77	92.42	101.37	104.35	101.58	97.75	87.63	74.03	65.90	84.71
GENERATED	MEAN	62.33	63.94*	71.18	81.37	90.86	99.80	101.12	98.80	92.07*	83.15	72.64	64.92	81.95
DAILY MINIMUM (F)														
DBSERVED	MEAN	38.61	41.29	45.54	52.31	60.57	69.13	78.50	76.85	69.73	57.60	46.28	39.24	56.39
GENERATED	MEAN	35.83	37.02	44.08	53.06	61.72	69.72	71.59*	70.39*	63.78*	54.93	44.77	38.33	53.86
MONTHLY/ANNUAL MAX (F)														
DBSERVED	MEAN	76.20	80.55	87.05	94.95	103.90	111.15	112.00	108.40	105.55	97.85	85.60	77.25	112.95
GENERATED	MEAN	78.80	78.63	87.17	95.60	103.80	109.90	110.67	108.73	103.83	97.93	87.50	81.60	112.13
MONTHLY/ANNUAL MIN (F)														
DBSERVED	MEAN	28.05	31.00	34.05	42.15	49.15	59.20	70.35	68.60	58.85	45.85	34.75	29.45	25.90
GENERATED	MEAN	25.10*	27.00*	31.70*	41.40	49.77	59.47	63.10*	60.07*	53.03*	42.70*	33.47	27.30*	22.67*
ND. DAYS > 95 F														
DBSERVED	MEAN	0.00	0.00	0.00	1.55	14.95	25.30	30.05	28.40	22.45	5.95	0.00	0.00	128.65
GENERATED	MEAN	0.00	0.00	0.07	1.37	9.53*	25.07	27.50*	23.80*	11.47*	2.60*	0.20	0.00	101.60*
ND. DAYS < 32 F														
DBSERVED	MEAN	5.35	2.70	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	3.80	13.15
GENERATED	MEAN	8.53*	6.03*	1.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	5.13	21.77*

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

TABLE 11. COMPARISON OF GENERATED AND OBSERVED WEATHER DATA, BOSTON, MA.

PRECIPITATION AMOUNT (IN)		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
OBSERVED	MEAN	3.73	3.97	4.43	3.91	3.58	3.08	2.71	3.71	3.45	3.31	4.61	4.72	45.21
GENERATED	MEAN	3.94	4.67	4.68	3.98	3.99	3.42	2.57	3.50	3.02	2.40*	4.66	4.17	45.01
NO. OF WET DAYS														
OBSERVED	MEAN	11.85	11.35	12.00	11.45	11.40	10.60	9.10	10.00	8.65	9.15	11.75	10.85	128.15
GENERATED	MEAN	11.33	11.20	11.90	10.70	11.43	10.50	8.53	9.40	7.63	7.90	10.90	9.80	121.23*
RUN OF WET DAYS														
OBSERVED	MEAN	3.85	3.40	3.90	3.80	4.25	3.40	3.10	3.00	2.90	3.55	3.70	3.05	6.70
GENERATED	MEAN	4.07	3.90	4.17	3.90	3.27	3.50	3.40	2.60	2.73	2.73	3.70	3.23	6.33
NO. DAYS > 2.0 IN														
OBSERVED	MEAN	0.00	0.20	0.10	0.10	0.15	0.05	0.15	0.25	0.40	0.20	0.25	0.15	2.00
GENERATED	MEAN	0.07	0.17	0.10	0.10	0.00	0.07	0.00*	0.10	0.13	0.03	0.17	0.17	1.10*
RADIATION MEAN DAILY (LY)														
OBSERVED	MEAN	147.7	212.8	301.7	386.2	485.8	504.4	499.1	430.9	359.6	253.2	151.6	127.9	322.8
GENERATED	MEAN	138.3	197.7	292.4	413.0	497.8	537.6	525.1	457.4	364.4	245.6	151.0	128.4	329.7

TABLE 11. CONTINUED.

TEMPERATURE		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	ANN.
DAILY MAXIMUM (F)														
OBSERVED	MEAN	36.04	37.86	43.96	56.14	66.87	76.66	81.72	79.63	72.26	62.76	51.40	39.54	58.85
GENERATED	MEAN	32.66	36.15	44.60	55.94	68.38	78.43	82.11	79.16	70.29	58.61	47.74	37.06	57.71
DAILY MINIMUM (F)														
OBSERVED	MEAN	22.17	23.32	30.68	40.27	49.47	59.09	65.05	63.31	56.55	47.22	38.14	26.36	43.58
GENERATED	MEAN	19.27	22.38	30.13	40.18	51.12	59.74	63.05*	60.53*	52.66*	42.27*	32.86*	23.40	41.57
MONTHLY/ANNUAL MAX (F)														
OBSERVED	MEAN	54.75	55.25	64.65	77.85	87.10	93.65	94.40	92.30	89.80	80.60	67.95	59.10	95.85
GENERATED	MEAN	49.87*	54.07	63.33	75.07	83.87*	88.53*	91.57*	90.83	85.73*	77.10*	65.60	54.60	93.47
MONTHLY/ANNUAL MIN (F)														
OBSERVED	MEAN	3.85	5.15	16.40	29.65	39.65	49.75	57.35	54.55	43.80	34.00	24.50	9.15	0.30
GENERATED	MEAN	5.33	8.93*	15.13	23.97*	39.10	52.87*	61.23*	54.90	41.03*	27.00*	16.60*	9.23	3.67
NO. DAYS > 95 F														
OBSERVED	MEAN	0.00	0.00	0.00	0.00	0.00	0.55	1.25	0.65	0.10	0.00	0.00	0.00	2.55
GENERATED	MEAN	0.00	0.00	0.00	0.00	0.03	0.00*	0.17*	0.20	0.00	0.00	0.00	0.00	0.40*
NO. DAYS < 32 F														
OBSERVED	MEAN	26.00	23.10	16.75	1.95	0.00	0.00	0.00	0.00	0.00	0.35	6.70	22.00	96.85
GENERATED	MEAN	30.07*	25.20*	18.40	5.73*	0.00	0.00	0.00	0.00	0.00	3.33*	14.00*	27.17*	123.90*

* -- GENERATED VALUES SIGNIFICANTLY DIFFERENT FROM OBSERVED VALUES AT 5% LEVEL BY T-TEST

Table 12. Comparison of data generated for Reynolds Mountain using precipitation and temperature correction procedure with observed weather data*

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	ANN.
PRECIPITATION													
Amount (in.)													
Observed mean	8.03	4.68	4.60	3.87	2.62	2.30	0.67	1.17	1.31	2.48	5.52	6.09	43.34
Generated mean	7.66	5.83	4.87	3.77	2.70	2.06	0.69	1.65	0.98	2.29	5.58	6.15	44.25
No. wet days													
Observed mean	16.8	13.3	15.1	12.9	10.6	10.0	4.7	6.0	5.4	8.9	13.3	16.6	133.5
Generated mean	12.5	12.2	9.2	8.1	8.6	6.3	1.8	3.3	3.3	6.1	8.9	12.3	92.6
TEMPERATURE													
Daily maximum (°F)													
Observed mean	27.2	31.0	33.0	38.7	50.8	61.8	72.1	70.1	60.9	48.8	36.0	29.3	46.6
Generated mean	27.2	30.8	32.9	38.8	50.8	61.9	71.5	69.5	61.1	48.9	35.8	30.2	46.7
Daily minimum (°F)													
Observed mean	17.8	21.4	21.2	24.7	34.7	44.0	53.4	52.1	44.0	34.7	25.3	19.5	32.7
Generated mean	17.1	21.6	21.0	24.2	34.8	44.3	53.1	52.4	44.6	34.5	25.0	20.2	32.8

* Generated values significantly different from observed values at 5% level by t-test.

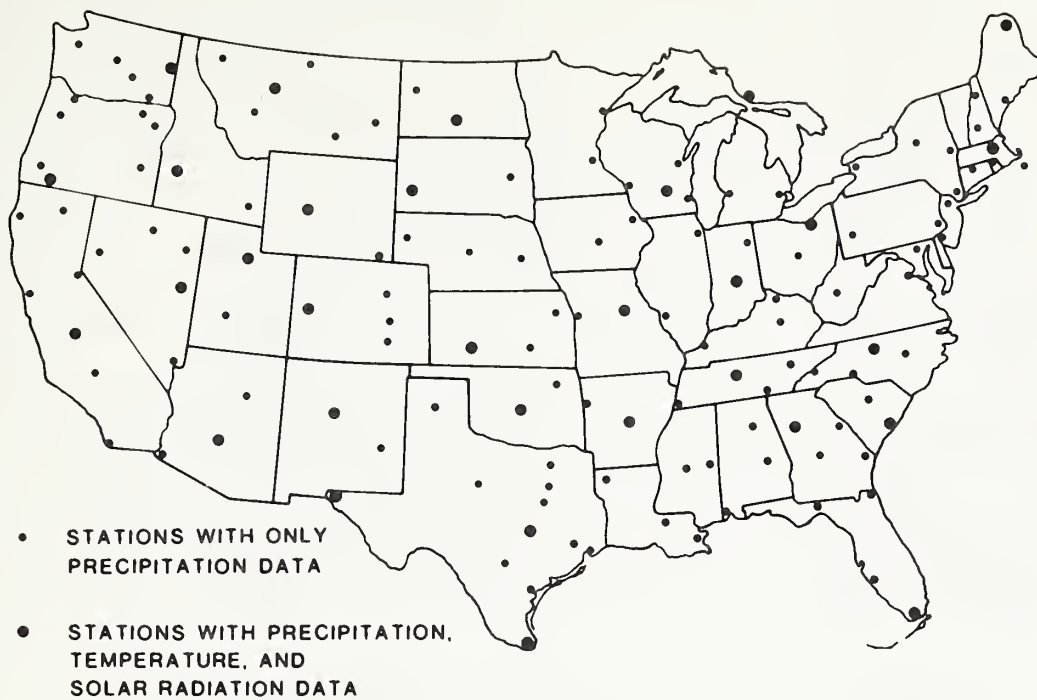


Figure 1. Location of stations used to define weather generation parameters.

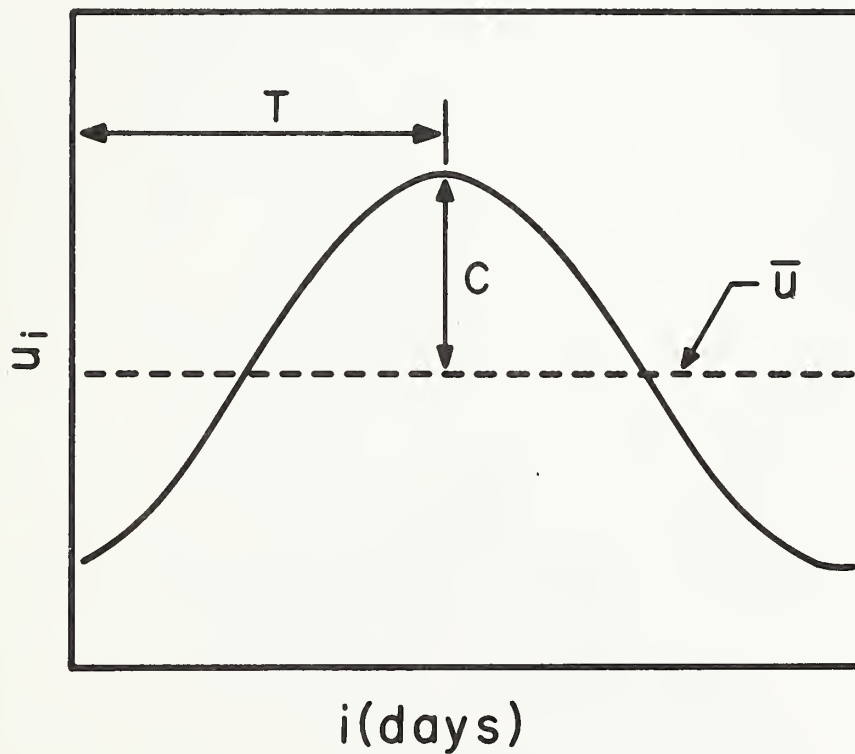
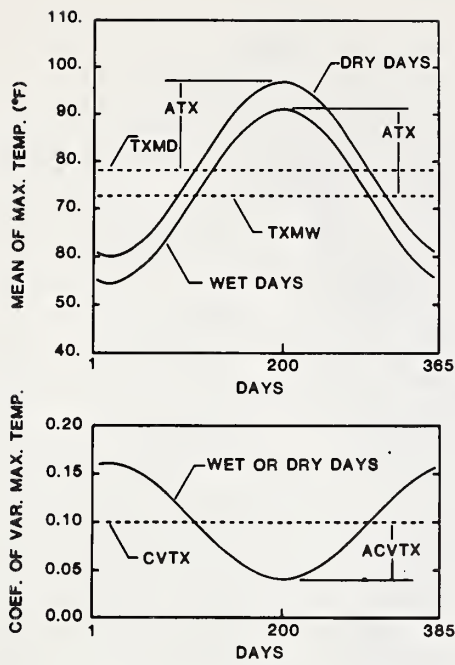
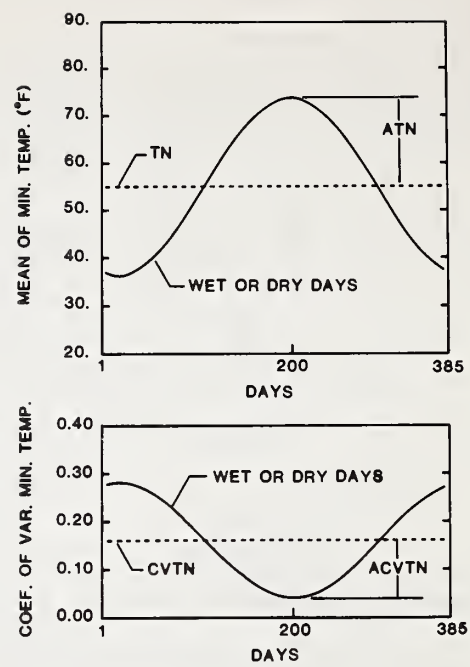


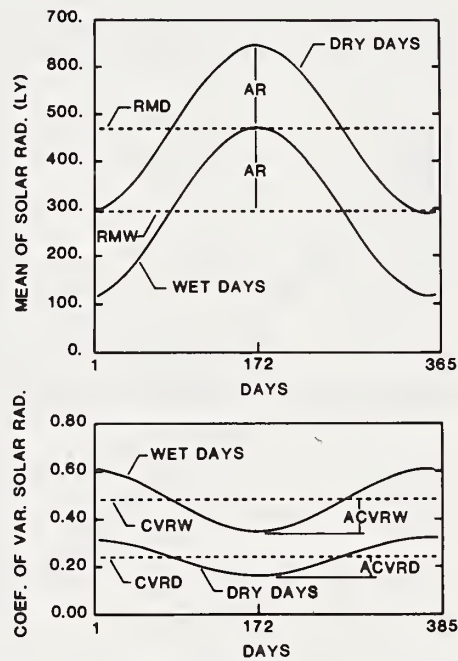
Figure 2. Definition of variables in seasonal description of temperature and solar radiation.



A, maximum temperature



B, minimum temperature



C, solar radiation

Figure 3. Definition of generation parameters for (A) maximum temperature, (B) minimum temperature, and (C) solar radiation.

APPENDIX A
Generation Parameters

TABLE A1. RAINFALL GENERATION PARAMETERS FOR LOCATIONS IN THE UNITED STATES.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
BIRMINGHAM, AL	P(W/W)	0.491	0.505	0.475	0.444	0.530	0.481	0.548	0.426	0.480	0.395	0.457
	P(W/D)	0.264	0.299	0.285	0.245	0.183	0.220	0.307	0.265	0.175	0.144	0.267
	ALPHA	0.643	0.640	0.648	0.712	0.675	0.626	0.802	0.660	0.676	0.630	0.715
	BETA	0.710	0.765	0.845	0.724	0.662	0.699	0.499	0.629	0.744	0.716	0.593
MOBILE, AL	P(W/W)	0.419	0.483	0.514	0.340	0.419	0.547	0.593	0.515	0.538	0.444	0.375
	P(W/D)	0.294	0.286	0.257	0.197	0.202	0.280	0.446	0.351	0.232	0.135	0.193
	ALPHA	0.577	0.629	0.556	0.512	0.644	0.623	0.713	0.686	0.548	0.645	0.613
	BETA	0.766	0.816	0.969	1.434	0.902	0.799	0.697	0.774	1.109	0.659	0.628
MONTGOMERY, AL	P(W/W)	0.447	0.456	0.435	0.380	0.475	0.457	0.436	0.408	0.514	0.444	0.348
	P(W/D)	0.269	0.289	0.262	0.219	0.185	0.220	0.317	0.264	0.166	0.117	0.175
	ALPHA	0.713	0.691	0.699	0.634	0.634	0.706	0.620	0.762	0.546	0.601	0.684
	BETA	0.525	0.680	0.786	0.852	0.681	0.589	0.648	0.408	1.179	0.767	0.619
FLAGSTAFF, AZ	P(W/W)	0.558	0.470	0.483	0.464	0.362	0.490	0.545	0.515	0.438	0.470	0.495
	P(W/D)	0.114	0.138	0.151	0.127	0.073	0.051	0.254	0.279	0.132	0.082	0.114
	ALPHA	0.895	0.889	0.854	0.945	0.983	0.592	0.826	0.782	0.659	0.811	0.689
	BETA	0.327	0.292	0.318	0.257	0.187	0.423	0.283	0.324	0.452	0.347	0.436
PHOENIX, AZ	P(W/W)	0.407	0.478	0.364	0.303	0.294	0.313	0.366	0.318	0.429	0.354	0.327
	P(W/D)	0.085	0.077	0.070	0.042	0.018	0.022	0.099	0.147	0.057	0.054	0.060
	ALPHA	0.825	0.822	0.998	0.883	0.899	0.629	0.752	0.650	0.532	0.680	0.917
	BETA	0.225	0.182	0.242	0.199	0.140	0.271	0.233	0.335	0.462	0.310	0.220
YUMA, AZ	P(W/W)	0.273	0.077	0.250	0.176	0.000	0.000	0.238	0.211	0.313	0.318	0.222
	P(W/D)	0.056	0.048	0.041	0.024	0.008	0.000	0.030	0.052	0.017	0.025	0.038
	ALPHA	0.841	0.763	0.998	0.517	0.802	0.000	0.637	0.670	0.394	0.686	0.624
	BETA	0.180	0.205	0.102	0.332	0.127	0.000	0.248	0.253	0.875	0.327	0.276
FORT SMITH, AR	P(W/W)	0.426	0.444	0.394	0.479	0.445	0.407	0.421	0.341	0.432	0.366	0.423
	P(W/D)	0.157	0.216	0.238	0.280	0.245	0.210	0.195	0.171	0.171	0.134	0.147
	ALPHA	0.655	0.701	0.719	0.709	0.658	0.632	0.590	0.650	0.752	0.625	0.638
	BETA	0.447	0.501	0.574	0.624	0.796	0.674	0.762	0.730	0.604	0.956	0.803
LITTLE ROCK, AR	P(W/W)	0.489	0.437	0.500	0.498	0.500	0.480	0.401	0.383	0.396	0.367	0.392
	P(W/D)	0.217	0.267	0.242	0.270	0.190	0.179	0.233	0.177	0.174	0.154	0.186
	ALPHA	0.619	0.681	0.790	0.686	0.554	0.651	0.703	0.581	0.624	0.659	0.633
	BETA	0.699	0.708	0.564	0.730	1.090	0.664	0.600	0.710	0.909	0.628	0.823
BAKERSFIELD, CA	P(W/W)	0.425	0.482	0.346	0.474	0.297	0.444	0.300	0.250	0.214	0.391	0.364
	P(W/D)	0.132	0.132	0.130	0.095	0.039	0.008	0.010	0.006	0.019	0.022	0.082
	ALPHA	0.966	0.827	0.845	0.822	0.841	0.805	0.800	0.796	0.893	0.967	0.999
	BETA	0.175	0.215	0.162	0.214	0.115	0.112	0.090	0.063	0.135	0.255	0.232

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
BLUE CANYON, CA	P(W/W)	0.731	0.678	0.663	0.631	0.556	0.488	0.067	0.296	0.370	0.437	0.628	0.710
	P(W/D)	0.208	0.213	0.231	0.184	0.155	0.073	0.025	0.032	0.054	0.090	0.200	0.174
	ALPHA	0.716	0.808	0.880	0.721	0.798	0.742	0.996	0.439	0.600	0.567	0.710	0.791
	BETA	1.597	1.053	0.798	0.777	0.463	0.350	0.070	0.615	0.456	1.694	1.188	1.432
EUREKA, CA	P(W/W)	0.754	0.693	0.724	0.615	0.518	0.398	0.122	0.306	0.397	0.529	0.691	0.718
	P(W/D)	0.331	0.265	0.261	0.209	0.167	0.128	0.064	0.058	0.095	0.177	0.272	0.266
	ALPHA	0.837	0.758	0.968	0.777	0.743	0.777	0.998	0.499	0.651	0.851	0.719	0.877
	BETA	0.556	0.506	0.331	0.359	0.295	0.150	0.050	0.289	0.275	0.379	0.622	0.510
FRESNO, CA	P(W/W)	0.509	0.519	0.393	0.477	0.340	0.158	0.050	0.050	0.154	0.286	0.484	0.475
	P(W/D)	0.172	0.156	0.140	0.105	0.056	0.024	0.010	0.010	0.017	0.034	0.098	0.154
	ALPHA	0.724	0.759	0.852	0.752	0.998	0.998	0.998	0.698	0.848	0.862	0.827	0.755
	BETA	0.384	0.333	0.313	0.357	0.134	0.076	0.080	0.095	0.187	0.287	0.351	0.336
MT SHASTA, CA	P(W/W)	0.718	0.675	0.646	0.591	0.563	0.466	0.258	0.378	0.386	0.490	0.628	0.689
	P(W/D)	0.233	0.211	0.206	0.154	0.137	0.101	0.042	0.049	0.049	0.097	0.200	0.185
	ALPHA	0.776	0.650	0.729	0.706	0.834	0.998	0.998	0.944	0.558	0.635	0.660	0.623
	BETA	0.724	0.782	0.461	0.471	0.284	0.182	0.150	0.188	0.607	0.593	0.842	0.962
SAN DIEGO, CA	P(W/W)	0.580	0.388	0.427	0.465	0.396	0.190	0.050	0.333	0.368	0.250	0.479	0.458
	P(W/D)	0.124	0.131	0.139	0.106	0.047	0.026	0.006	0.010	0.019	0.046	0.103	0.111
	ALPHA	0.683	0.659	0.737	0.734	0.867	0.998	0.998	0.617	0.847	0.578	0.785	0.708
	BETA	0.398	0.392	0.301	0.235	0.084	0.064	0.040	0.233	0.223	0.230	0.318	0.373
SAN FRANCISCO, CA	P(W/W)	0.662	0.602	0.566	0.515	0.429	0.250	0.091	0.238	0.280	0.385	0.587	0.680
	P(W/D)	0.225	0.193	0.203	0.121	0.063	0.042	0.016	0.030	0.028	0.090	0.168	0.166
	ALPHA	0.725	0.762	0.762	0.803	0.744	0.512	0.900	0.769	0.486	0.535	0.702	0.761
	BETA	0.550	0.385	0.338	0.329	0.199	0.254	0.150	0.083	0.420	0.478	0.423	0.487
COLORADO SPRINGS, CO	P(W/W)	0.333	0.400	0.467	0.456	0.530	0.487	0.521	0.559	0.423	0.424	0.366	0.329
	P(W/D)	0.098	0.123	0.173	0.159	0.232	0.235	0.400	0.253	0.140	0.111	0.098	0.087
	ALPHA	0.905	0.998	0.850	0.656	0.601	0.607	0.708	0.755	0.716	0.774	0.885	0.988
	BETA	0.077	0.068	0.114	0.264	0.361	0.380	0.300	0.278	0.302	0.224	0.141	0.070
DENVER, CO	P(W/W)	0.423	0.384	0.503	0.483	0.540	0.443	0.435	0.373	0.419	0.408	0.427	0.394
	P(W/D)	0.130	0.177	0.201	0.202	0.208	0.246	0.237	0.228	0.149	0.113	0.122	0.126
	ALPHA	0.781	0.853	0.790	0.655	0.611	0.637	0.634	0.600	0.693	0.690	0.948	0.988
	BETA	0.118	0.152	0.179	0.292	0.453	0.295	0.333	0.278	0.292	0.312	3.149	0.093
GRAND JUNCTION, CO	P(W/W)	0.407	0.410	0.388	0.404	0.476	0.427	0.318	0.384	0.391	0.475	0.385	0.344
	P(W/D)	0.173	0.183	0.179	0.168	0.107	0.086	0.114	0.184	0.136	0.107	0.127	0.169
	ALPHA	0.947	0.994	0.998	0.849	0.821	0.835	0.764	0.794	0.840	0.983	0.918	0.973
	BETA	0.096	0.089	0.093	0.128	0.150	0.155	0.121	0.189	0.176	0.172	0.131	0.099

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
PUEBLO, CO												
P(W/W)	0.362	0.411	0.455	0.404	0.455	0.417	0.370	0.417	0.301	0.372	0.292	0.435
P(W/D)	0.104	0.113	0.136	0.116	0.172	0.180	0.246	0.230	0.143	0.092	0.093	0.071
ALPHA	0.935	0.998	0.966	0.634	0.650	0.693	0.720	0.615	0.661	0.719	0.939	0.928
BETA	0.066	0.065	0.100	0.327	0.322	0.227	0.294	0.346	0.246	0.322	0.141	0.091
WINDSOR LKS, CT												
P(W/W)	0.406	0.454	0.445	0.475	0.412	0.469	0.356	0.387	0.444	0.421	0.513	0.493
P(W/D)	0.311	0.311	0.301	0.310	0.309	0.295	0.275	0.274	0.236	0.182	0.297	0.297
ALPHA	0.780	0.650	0.755	0.689	0.725	0.667	0.702	0.594	0.556	0.641	0.687	0.694
BETA	3.555	0.485	0.487	0.504	0.369	0.454	0.467	0.718	0.750	0.694	0.530	0.506
WILMINGTON, DE												
P(W/W)	0.450	0.410	0.451	0.482	0.462	0.393	0.401	0.420	0.437	0.428	0.460	0.476
P(W/D)	0.263	0.282	0.312	0.318	0.291	0.244	0.251	0.244	0.172	0.162	0.245	0.226
ALPHA	0.783	0.727	0.732	0.771	0.692	0.674	0.578	0.684	0.592	0.667	0.699	0.746
BETA	0.335	0.435	0.468	0.377	0.364	0.537	0.774	0.655	0.852	0.550	0.514	0.494
DISTRICT OF COLUMBIA												
P(W/W)	0.424	0.415	0.452	0.478	0.455	0.377	0.400	0.441	0.406	0.394	0.361	0.410
P(W/D)	0.265	0.254	0.303	0.276	0.260	0.269	0.243	0.231	0.179	0.162	0.242	0.244
ALPHA	0.834	0.811	0.828	0.789	0.751	0.622	0.581	0.607	0.635	0.628	0.731	0.679
BETA	0.299	0.384	0.387	0.383	0.423	0.604	0.793	0.810	0.645	0.610	0.478	0.508
JACKSONVILLE, FL												
P(W/W)	0.401	0.398	0.408	0.320	0.477	0.564	0.555	0.584	0.598	0.505	0.330	0.370
P(W/D)	0.212	0.253	0.190	0.172	0.181	0.294	0.391	0.342	0.320	0.200	0.157	0.191
ALPHA	0.677	0.731	0.626	0.670	0.586	0.651	0.676	0.613	0.622	0.545	0.665	0.677
BETA	0.486	0.670	0.693	0.676	0.770	0.800	0.706	0.926	0.795	0.869	0.419	0.500
MIAMI, FL												
P(W/W)	0.328	0.354	0.286	0.345	0.597	0.631	0.624	0.599	0.697	0.650	0.359	0.360
P(W/D)	0.182	0.173	0.174	0.160	0.196	0.413	0.382	0.422	0.401	0.319	0.196	0.142
ALPHA	0.622	0.634	0.662	0.611	0.601	0.679	0.707	0.635	0.631	0.549	0.549	0.562
BETA	0.553	0.577	0.513	0.735	1.091	0.914	0.559	0.657	0.799	1.027	0.680	0.533
TALLAHASSEE, FL												
P(W/W)	0.387	0.433	0.404	0.379	0.483	0.573	0.633	0.577	0.500	0.437	0.344	0.387
P(W/D)	0.241	0.286	0.225	0.187	0.206	0.304	0.496	0.329	0.254	0.110	0.163	0.219
ALPHA	0.744	0.696	0.628	0.591	0.722	0.652	0.670	0.745	0.555	0.656	0.625	0.696
BETA	0.583	0.830	0.973	0.901	0.628	0.836	0.727	0.665	1.288	0.903	0.768	0.780
TAMPA, FL												
P(W/W)	0.309	0.409	0.397	0.370	0.359	0.568	0.602	0.583	0.553	0.438	0.327	0.267
P(W/D)	0.180	0.201	0.169	0.118	0.169	0.270	0.436	0.474	0.350	0.178	0.132	0.181
ALPHA	0.669	0.719	0.631	0.687	0.578	0.655	0.624	0.701	0.632	0.672	0.641	0.687
BETA	0.526	0.634	0.951	0.621	0.758	0.713	0.811	0.668	0.719	0.490	0.646	0.497
ATLANTA, GA												
P(W/W)	0.502	0.490	0.433	0.426	0.462	0.473	0.548	0.437	0.490	0.561	0.385	0.468
P(W/D)	0.261	0.291	0.286	0.247	0.188	0.258	0.318	0.208	0.163	0.119	0.207	0.258
ALPHA	0.718	0.727	0.689	0.723	0.728	0.765	0.681	0.711	0.661	0.622	0.668	0.743
BETA	0.566	0.618	0.734	0.717	0.613	0.453	0.571	0.561	0.671	0.627	0.621	0.589

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
AUGUSTA, GA	P(W/W)	0.477	0.434	0.473	0.436	0.503	0.492	0.532	0.437	0.458	0.482	0.414
	P(W/D)	0.232	0.290	0.253	0.220	0.183	0.227	0.271	0.233	0.180	0.113	0.165
	ALPHA	0.733	0.797	0.689	0.637	0.754	0.813	0.614	0.641	0.594	0.618	0.738
	BETA	0.528	0.537	0.654	0.657	0.556	0.511	0.696	0.695	0.632	0.558	0.463
MACON, GA	P(W/W)	0.468	0.519	0.478	0.398	0.524	0.472	0.559	0.502	0.503	0.492	0.370
	P(W/D)	0.250	0.283	0.263	0.214	0.182	0.257	0.340	0.239	0.184	0.118	0.176
	ALPHA	0.701	0.799	0.666	0.632	0.597	0.637	0.692	0.751	0.623	0.594	0.734
	BETA	0.527	0.559	0.710	0.693	0.730	0.630	0.511	0.472	0.631	0.653	0.437
SAVANNAH, GA	P(W/W)	0.439	0.417	0.418	0.321	0.452	0.551	0.577	0.551	0.502	0.463	0.375
	P(W/D)	0.229	0.283	0.251	0.194	0.203	0.264	0.394	0.292	0.244	0.131	0.158
	ALPHA	0.737	0.718	0.710	0.712	0.626	0.689	0.671	0.653	0.622	0.582	0.600
	BETA	0.456	0.499	0.602	0.623	0.861	0.775	0.798	0.823	0.825	0.692	0.474
BOISE, ID	P(W/W)	0.595	0.559	0.459	0.406	0.476	0.464	0.250	0.353	0.370	0.389	0.534
	P(W/D)	0.317	0.235	0.223	0.211	0.196	0.150	0.053	0.063	0.083	0.152	0.213
	ALPHA	0.846	0.920	0.998	0.841	0.740	0.854	0.826	0.676	0.801	0.998	0.998
	BETA	0.148	0.115	0.101	0.180	0.211	0.176	0.113	0.202	0.159	0.115	0.139
POCATELLO, ID	P(W/W)	0.511	0.524	0.479	0.380	0.508	0.509	0.286	0.360	0.353	0.370	0.450
	P(W/D)	0.289	0.253	0.230	0.213	0.194	0.169	0.095	0.107	0.099	0.110	0.194
	ALPHA	0.949	0.998	0.998	0.998	0.794	0.824	0.850	0.706	0.836	0.884	0.987
	BETA	0.097	0.080	0.082	0.145	0.167	0.185	0.111	0.199	0.146	0.165	0.111
CHICAGO, IL	P(W/W)	0.430	0.430	0.485	0.559	0.441	0.458	0.437	0.357	0.455	0.456	0.460
	P(W/D)	0.291	0.285	0.330	0.332	0.293	0.288	0.270	0.202	0.214	0.193	0.236
	ALPHA	0.681	0.782	0.705	0.733	0.783	0.692	0.602	0.689	0.718	0.640	0.735
	BETA	0.251	0.206	0.297	0.424	0.357	0.548	0.735	0.652	0.500	0.537	0.325
EVANSVILLE, IN	P(W/W)	0.467	0.457	0.485	0.483	0.493	0.459	0.455	0.393	0.418	0.446	0.440
	P(W/D)	0.242	0.276	0.288	0.336	0.252	0.243	0.263	0.181	0.170	0.166	0.214
	ALPHA	0.673	0.725	0.622	0.669	0.697	0.676	0.743	0.654	0.629	0.659	0.707
	BETA	0.479	0.472	0.635	0.509	0.608	0.508	0.517	0.593	0.604	0.504	0.507
FORTWAYNE, IN	P(W/W)	0.496	0.463	0.552	0.535	0.502	0.493	0.439	0.393	0.424	0.434	0.461
	P(W/D)	0.326	0.309	0.359	0.389	0.305	0.253	0.297	0.217	0.238	0.202	0.277
	ALPHA	0.667	0.676	0.743	0.781	0.830	0.838	0.713	0.762	0.758	0.653	0.830
	BETA	0.280	0.294	0.275	0.346	0.385	0.435	0.489	0.467	0.359	0.525	0.313
INDIANAPOLIS, IN	P(W/W)	0.466	0.462	0.496	0.543	0.513	0.421	0.406	0.358	0.415	0.428	0.412
	P(W/D)	0.291	0.277	0.344	0.332	0.304	0.266	0.273	0.218	0.192	0.175	0.259
	ALPHA	0.630	0.692	0.688	0.749	0.845	0.671	0.746	0.753	0.646	0.689	0.733
	BETA	0.387	0.362	0.423	0.430	0.390	0.578	0.582	0.437	0.580	0.507	0.461

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
DES MOINES, IA	P(W/W)	0.391	0.397	0.490	0.466	0.455	0.489	0.367	0.393	0.444	0.389	0.403
	P(W/D)	0.205	0.212	0.255	0.317	0.286	0.295	0.257	0.252	0.238	0.183	0.200
	ALPHA	0.762	0.821	0.698	0.713	0.681	0.664	0.697	0.693	0.691	0.661	0.536
	BETA	0.157	0.172	0.302	0.370	0.572	0.567	0.530	0.552	0.499	0.409	0.149
DUBUQUE, IA	P(W/W)	0.411	0.396	0.483	0.472	0.478	0.475	0.405	0.395	0.422	0.475	0.391
	P(W/D)	0.234	0.212	0.269	0.326	0.301	0.286	0.298	0.219	0.237	0.184	0.248
	ALPHA	0.722	0.804	0.814	0.802	0.733	0.752	0.673	0.752	0.644	0.746	0.595
	BETA	0.227	0.201	0.344	0.484	0.558	0.564	0.674	0.680	0.795	0.528	0.633
DODGE CITY, KS	P(W/W)	0.287	0.305	0.397	0.402	0.484	0.492	0.421	0.441	0.442	0.425	0.411
	P(W/D)	0.109	0.138	0.150	0.157	0.233	0.213	0.247	0.209	0.144	0.096	0.103
	ALPHA	0.927	0.795	0.660	0.733	0.670	0.750	0.709	0.616	0.591	0.592	0.783
	BETA	0.096	0.138	0.296	0.294	0.500	0.453	0.485	0.454	0.521	0.500	0.191
TOPEDA, KS	P(W/W)	0.336	0.301	0.480	0.471	0.460	0.471	0.442	0.381	0.419	0.419	0.388
	P(W/D)	0.151	0.186	0.172	0.243	0.293	0.294	0.228	0.215	0.202	0.147	0.123
	ALPHA	0.773	0.708	0.748	0.626	0.780	0.720	0.693	0.652	0.755	0.695	0.592
	BETA	0.169	0.234	0.343	0.543	0.441	0.740	0.685	0.698	0.551	0.560	0.469
WICHITA, KS	P(W/W)	0.500	0.316	0.462	0.419	0.393	0.577	0.433	0.357	0.412	0.231	0.400
	P(W/D)	0.060	0.212	0.194	0.322	0.246	0.188	0.254	0.292	0.123	0.137	0.111
	ALPHA	0.621	0.734	0.524	0.551	0.690	0.786	0.640	0.989	0.724	0.998	0.609
	BETA	0.256	0.256	0.666	0.503	0.640	0.628	0.634	0.304	0.639	0.416	0.232
COVINGTON, KY	P(W/W)	0.492	0.477	0.487	0.561	0.561	0.467	0.393	0.418	0.397	0.416	0.480
	P(W/D)	0.326	0.332	0.380	0.343	0.265	0.259	0.283	0.211	0.198	0.197	0.289
	ALPHA	0.655	0.708	0.603	0.696	0.794	0.672	0.763	0.648	0.797	0.719	0.680
	BETA	0.405	0.378	0.501	0.388	0.411	0.527	0.589	0.459	0.420	0.400	0.403
LEXINGTON, KY	P(W/W)	0.496	0.489	0.502	0.520	0.500	0.526	0.430	0.394	0.441	0.400	0.459
	P(W/D)	0.317	0.345	0.356	0.353	0.292	0.273	0.312	0.245	0.176	0.194	0.267
	ALPHA	0.630	0.751	0.652	0.647	0.680	0.778	0.734	0.631	0.666	0.725	0.708
	BETA	0.464	0.396	0.577	0.478	0.535	0.507	0.560	0.603	0.587	0.363	0.462
LOUISVILLE, KY	P(W/W)	0.472	0.466	0.484	0.512	0.547	0.513	0.449	0.379	0.420	0.383	0.439
	P(W/D)	0.301	0.323	0.355	0.331	0.256	0.222	0.297	0.201	0.182	0.188	0.257
	ALPHA	0.662	0.709	0.645	0.664	0.723	0.680	0.743	0.692	0.648	0.752	0.628
	BETA	0.447	0.453	0.586	0.497	0.489	0.549	0.463	0.576	0.664	0.435	0.517
BATON ROUGE, LA	P(W/W)	0.381	0.466	0.398	0.376	0.506	0.531	0.560	0.452	0.416	0.376	0.305
	P(W/D)	0.251	0.267	0.220	0.182	0.180	0.194	0.363	0.279	0.219	0.121	0.180
	ALPHA	0.654	0.664	0.645	0.582	0.652	0.811	0.700	0.767	0.721	0.617	0.712
	BETA	0.684	0.832	0.739	1.311	0.804	0.452	0.712	0.568	0.580	0.836	0.742

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
NEW ORLEANS, LA	P(W/W)	0.409	0.458	0.404	0.343	0.439	0.483	0.576	0.536	0.495	0.433	0.369
	P(W/D)	0.253	0.279	0.227	0.197	0.191	0.258	0.368	0.329	0.237	0.130	0.168
	ALPHA	0.575	0.615	0.570	0.604	0.660	0.691	0.705	0.642	0.646	0.694	0.593
	BETA	0.865	0.903	0.871	0.935	0.870	0.641	0.684	0.670	0.846	0.571	0.825
SHREVEPORT, LA	P(W/W)	0.497	0.434	0.436	0.430	0.488	0.497	0.375	0.375	0.444	0.376	0.429
	P(W/D)	0.221	0.237	0.248	0.245	0.186	0.154	0.187	0.163	0.163	0.131	0.205
	ALPHA	0.625	0.699	0.729	0.665	0.668	0.578	0.607	0.527	0.663	0.713	0.652
	BETA	0.599	0.621	0.514	0.875	0.834	0.868	0.637	0.759	0.740	0.583	0.692
CARIBOU, ME	P(W/W)	0.516	0.518	0.539	0.508	0.531	0.472	0.500	0.508	0.473	0.498	0.573
	P(W/D)	0.409	0.368	0.315	0.318	0.332	0.376	0.424	0.367	0.361	0.316	0.389
	ALPHA	0.779	0.826	0.756	0.808	0.858	0.782	0.719	0.682	0.609	0.676	0.788
	BETA	0.192	0.217	0.227	0.264	0.248	0.318	0.385	0.438	0.487	0.400	0.304
PORTLAND, ME	P(W/W)	0.442	0.422	0.475	0.536	0.473	0.451	0.361	0.364	0.416	0.484	0.515
	P(W/D)	0.295	0.341	0.281	0.310	0.321	0.310	0.261	0.299	0.234	0.229	0.308
	ALPHA	0.765	0.672	0.716	0.717	0.714	0.651	0.724	0.708	0.631	0.603	0.691
	BETA	0.413	0.540	0.490	0.421	0.370	0.423	0.402	0.384	0.597	0.614	0.605
BALTIMORE, MD	P(W/W)	0.446	0.411	0.504	0.502	0.447	0.392	0.333	0.458	0.421	0.365	0.414
	P(W/D)	0.263	0.264	0.293	0.319	0.277	0.260	0.243	0.247	0.180	0.164	0.251
	ALPHA	0.791	0.791	0.713	0.698	0.707	0.631	0.592	0.617	0.530	0.698	0.653
	BETA	0.334	0.430	0.462	0.419	0.418	0.639	0.771	0.746	0.817	0.599	0.548
BOSTON, MA	P(W/W)	0.460	0.476	0.500	0.511	0.461	0.443	0.402	0.401	0.375	0.454	0.523
	P(W/D)	0.333	0.359	0.315	0.302	0.313	0.305	0.248	0.286	0.252	0.229	0.307
	ALPHA	0.689	0.618	0.662	0.720	0.670	0.680	0.663	0.582	0.562	0.607	0.601
	BETA	0.456	0.564	0.558	0.474	0.469	0.427	0.448	0.637	0.709	0.596	0.653
NANTUCKET, MA	P(W/W)	0.498	0.443	0.445	0.483	0.412	0.355	0.316	0.397	0.461	0.448	0.527
	P(W/D)	0.353	0.369	0.352	0.316	0.281	0.223	0.218	0.255	0.212	0.214	0.319
	ALPHA	0.763	0.697	0.723	0.699	0.652	0.660	0.636	0.644	0.571	0.665	0.660
	BETA	0.415	0.538	0.488	0.465	0.507	0.402	0.603	0.656	0.727	0.591	0.545
DETROIT, MI	P(W/W)	0.496	0.465	0.500	0.527	0.463	0.455	0.357	0.352	0.450	0.468	0.493
	P(W/D)	0.351	0.329	0.335	0.332	0.313	0.289	0.241	0.225	0.221	0.180	0.262
	ALPHA	0.695	0.775	0.772	0.741	0.684	0.776	0.713	0.704	0.778	0.672	0.743
	BETA	0.211	0.203	0.231	0.339	0.345	0.388	0.475	0.528	0.335	0.440	0.289
GRAND RAPIDS, MI	P(W/W)	0.661	0.510	0.554	0.534	0.469	0.408	0.391	0.382	0.438	0.476	0.578
	P(W/D)	0.362	0.392	0.352	0.333	0.278	0.288	0.252	0.218	0.276	0.230	0.295
	ALPHA	0.802	0.788	0.762	0.772	0.706	0.699	0.756	0.757	0.646	0.673	0.727
	BETA	0.153	0.157	0.228	0.373	0.379	0.514	0.438	0.462	0.508	0.451	0.322

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
DULUTH, MN												
P(W/W)	0.528	0.463	0.474	0.498	0.546	0.506	0.439	0.444	0.509	0.524	0.559	0.574
P(W/D)	0.291	0.272	0.269	0.291	0.342	0.324	0.307	0.324	0.298	0.212	0.239	0.296
ALPHA	0.819	0.798	0.676	0.713	0.723	0.700	0.701	0.635	0.716	0.688	0.618	0.730
BETA	0.114	0.113	0.225	0.320	0.349	0.478	0.487	0.511	0.395	0.330	0.266	0.159
MINNEAPOLIS, MN												
P(W/W)	0.416	0.414	0.419	0.407	0.502	0.496	0.361	0.383	0.455	0.431	0.407	0.447
P(W/D)	0.221	0.188	0.275	0.283	0.321	0.331	0.304	0.266	0.252	0.182	0.198	0.247
ALPHA	0.826	0.730	0.670	0.785	0.751	0.760	0.627	0.732	0.771	0.642	0.675	0.826
BETA	0.103	0.170	0.263	0.268	0.372	0.419	0.620	0.492	0.359	0.392	0.224	0.117
COLUMBIA, MO												
P(W/W)	0.412	0.405	0.456	0.477	0.445	0.473	0.454	0.340	0.415	0.403	0.353	0.424
P(W/D)	0.181	0.224	0.274	0.309	0.279	0.279	0.243	0.205	0.199	0.182	0.163	0.208
ALPHA	0.643	0.712	0.695	0.816	0.803	0.677	0.706	0.662	0.612	0.585	0.735	0.750
BETA	0.315	0.318	0.359	0.374	0.503	0.596	0.605	0.565	0.805	0.745	0.368	0.275
KANSAS CITY, MO												
P(W/W)	0.364	0.304	0.438	0.485	0.439	0.450	0.393	0.443	0.448	0.464	0.357	0.381
P(W/D)	0.157	0.216	0.215	0.260	0.305	0.284	0.235	0.203	0.214	0.156	0.135	0.166
ALPHA	0.727	0.713	0.682	0.754	0.687	0.786	0.672	0.646	0.662	0.695	0.553	0.859
BETA	0.259	0.288	0.440	0.454	0.580	0.654	0.783	0.736	0.780	0.633	0.521	0.238
ST. LOUIS, MO												
P(W/W)	0.405	0.384	0.477	0.487	0.476	0.487	0.438	0.375	0.426	0.387	0.440	0.453
P(W/D)	0.195	0.254	0.276	0.328	0.273	0.243	0.224	0.201	0.190	0.184	0.193	0.218
ALPHA	0.753	0.670	0.725	0.814	0.716	0.664	0.674	0.735	0.796	0.813	0.692	0.753
BETA	0.281	0.392	0.363	0.392	0.473	0.642	0.623	0.437	0.434	0.417	0.431	0.306
JACKSON, MS												
P(W/W)	0.516	0.454	0.458	0.364	0.539	0.450	0.451	0.394	0.429	0.396	0.389	0.488
P(W/D)	0.262	0.287	0.258	0.267	0.170	0.205	0.289	0.246	0.174	0.126	0.217	0.267
ALPHA	0.636	0.758	0.670	0.657	0.684	0.673	0.759	0.623	0.540	0.551	0.652	0.679
BETA	0.605	0.573	0.720	0.840	0.775	0.598	0.516	0.630	0.843	0.749	0.661	0.725
MERIDIAN, MS												
P(W/W)	0.411	0.441	0.414	0.399	0.434	0.412	0.456	0.402	0.429	0.436	0.317	0.439
P(W/D)	0.260	0.281	0.244	0.224	0.174	0.199	0.290	0.243	0.171	0.108	0.195	0.252
ALPHA	0.812	0.786	0.764	0.835	0.800	0.874	0.783	0.740	0.753	0.590	0.836	0.853
BETA	0.530	0.622	0.766	0.702	0.599	0.523	0.571	0.569	0.583	0.815	0.543	0.698
BILLINGS, MT												
P(W/W)	0.442	0.500	0.439	0.475	0.544	0.491	0.328	0.376	0.414	0.307	0.347	0.489
P(W/D)	0.198	0.184	0.241	0.233	0.270	0.314	0.177	0.170	0.165	0.160	0.166	0.139
ALPHA	0.998	0.998	0.845	0.775	0.740	0.728	0.662	0.743	0.753	0.768	0.732	0.911
BETA	0.094	0.095	0.130	0.267	0.261	0.290	0.189	0.218	0.241	0.191	0.181	0.111
GREAT FALLS, MT												
P(W/W)	0.526	0.490	0.478	0.490	0.523	0.564	0.383	0.457	0.428	0.393	0.453	0.481
P(W/D)	0.210	0.211	0.207	0.245	0.269	0.297	0.177	0.162	0.169	0.129	0.156	0.178
ALPHA	0.923	0.913	0.998	0.738	0.675	0.692	0.818	0.731	0.787	0.914	0.899	0.988
BETA	0.113	0.111	0.104	0.193	0.339	0.356	0.201	0.223	0.184	0.151	0.132	0.092

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
HAVRE, MT	P(W/W)	0.503	0.481	0.317	0.449	0.457	0.500	0.433	0.424	0.433	0.273	0.394
	P(W/D)	0.189	0.162	0.169	0.183	0.237	0.308	0.154	0.152	0.163	0.138	0.130
	ALPHA	0.998	0.998	0.998	0.883	0.747	0.712	0.781	0.669	0.752	0.765	0.940
	BETA	0.062	0.061	0.065	0.179	0.226	0.292	0.271	0.274	0.206	0.166	0.095
HELENA, MT	P(W/W)	0.429	0.328	0.421	0.373	0.498	0.573	0.381	0.361	0.446	0.331	0.390
	P(W/D)	0.215	0.184	0.200	0.249	0.260	0.266	0.180	0.207	0.147	0.159	0.185
	ALPHA	0.998	0.982	0.843	0.805	0.726	0.891	0.883	0.804	0.844	0.802	0.866
	BETA	0.070	0.071	0.106	0.143	0.232	0.213	0.152	0.175	0.142	0.134	0.095
KALISPELL, MT	P(W/W)	0.658	0.567	0.539	0.429	0.518	0.563	0.310	0.510	0.525	0.540	0.525
	P(W/D)	0.383	0.309	0.249	0.250	0.264	0.310	0.145	0.164	0.197	0.217	0.322
	ALPHA	0.998	0.998	0.998	0.834	0.862	0.807	0.829	0.798	0.866	0.968	0.857
	BETA	0.100	0.083	0.073	0.135	0.185	0.248	0.186	0.219	0.163	0.114	0.132
MILES CITY, MT	P(W/W)	0.444	0.467	0.385	0.488	0.507	0.491	0.344	0.386	0.460	0.324	0.355
	P(W/D)	0.212	0.193	0.200	0.213	0.262	0.309	0.230	0.166	0.146	0.135	0.159
	ALPHA	0.998	0.988	0.958	0.869	0.741	0.744	0.666	0.699	0.797	0.848	0.861
	BETA	0.063	0.077	0.084	0.182	0.265	0.346	0.294	0.242	0.186	0.122	0.114
GRAND ISLAND, NE	P(W/W)	0.409	0.422	0.413	0.514	0.474	0.500	0.353	0.383	0.441	0.308	0.250
	P(W/D)	0.108	0.181	0.178	0.204	0.278	0.259	0.271	0.221	0.188	0.113	0.109
	ALPHA	0.841	0.795	0.745	0.645	0.724	0.745	0.668	0.647	0.650	0.885	0.780
	BETA	0.120	0.155	0.224	0.441	0.478	0.546	0.476	0.501	0.471	0.263	0.159
ELKO, NV	P(W/W)	0.467	0.533	0.420	0.476	0.532	0.547	0.310	0.354	0.250	0.338	0.496
	P(W/D)	0.224	0.216	0.212	0.163	0.176	0.130	0.095	0.091	0.083	0.080	0.146
	ALPHA	0.797	0.928	0.958	0.905	0.960	0.809	0.828	0.565	0.779	0.738	0.998
	BETA	0.164	0.091	0.108	0.115	0.117	0.189	0.114	0.310	0.131	0.193	0.124
LAS VEGAS, NV	P(W/W)	0.271	0.311	0.346	0.250	0.211	0.071	0.275	0.161	0.258	0.300	0.333
	P(W/D)	0.061	0.065	0.055	0.048	0.025	0.022	0.067	0.082	0.040	0.041	0.056
	ALPHA	0.808	0.921	0.802	0.749	0.727	0.669	0.672	0.543	0.629	0.799	0.605
	BETA	0.200	0.125	0.149	0.182	0.157	0.245	0.263	0.340	0.313	0.155	0.380
RENO, NV	P(W/W)	0.496	0.454	0.380	0.349	0.414	0.386	0.294	0.420	0.297	0.250	0.500
	P(W/D)	0.138	0.113	0.135	0.101	0.101	0.074	0.067	0.049	0.044	0.046	0.093
	ALPHA	0.728	0.748	0.838	0.721	0.663	0.942	0.998	0.900	0.960	0.701	0.813
	BETA	0.275	0.258	0.150	0.182	0.253	0.138	0.095	0.107	0.158	0.233	0.166
WINNEMULLA, NV	P(W/W)	0.467	0.426	0.443	0.351	0.448	0.554	0.243	0.289	0.340	0.385	0.496
	P(W/D)	0.198	0.177	0.153	0.146	0.147	0.113	0.053	0.052	0.058	0.087	0.149
	ALPHA	0.928	0.961	0.998	0.786	0.899	0.718	0.787	0.759	0.783	0.761	0.998
	BETA	0.123	0.115	0.094	0.172	0.138	0.224	0.106	0.192	0.142	0.179	0.123

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
CONCORD, NH												
P(W/W)	0.405	0.396	0.459	0.441	0.463	0.457	0.368	0.403	0.409	0.422	0.494	0.461
P(W/D)	0.300	0.307	0.295	0.321	0.317	0.296	0.298	0.295	0.241	0.211	0.333	0.293
ALPHA	0.774	0.800	0.809	0.873	0.763	0.723	0.741	0.654	0.718	0.710	0.701	0.670
BETA	0.314	0.347	0.320	0.317	0.322	0.385	0.407	0.469	0.507	0.516	0.473	0.475
MT WASHINGTON, NH												
P(W/W)	0.648	0.673	0.724	0.710	0.632	0.628	0.616	0.638	0.634	0.646	0.726	0.714
P(W/D)	0.524	0.569	0.441	0.436	0.397	0.439	0.473	0.416	0.409	0.313	0.495	0.537
ALPHA	0.789	0.619	0.735	0.822	0.794	0.972	0.849	0.893	0.787	0.808	0.734	0.695
BETA	0.390	0.727	0.463	0.391	0.470	0.407	0.494	0.520	0.536	0.551	0.551	0.561
ALBUQUERQUE, NM												
P(W/W)	0.263	0.392	0.346	0.264	0.346	0.412	0.395	0.429	0.320	0.378	0.339	0.350
P(W/D)	0.080	0.090	0.095	0.073	0.094	0.077	0.253	0.240	0.129	0.090	0.070	0.093
ALPHA	0.840	0.998	0.964	0.712	0.699	0.718	0.744	0.804	0.836	0.739	0.998	0.858
BETA	0.112	0.101	0.124	0.205	0.139	0.213	0.209	0.191	0.182	0.294	0.111	0.156
ALBANY, NY												
P(W/W)	0.456	0.441	0.471	0.519	0.516	0.461	0.391	0.358	0.360	0.425	0.474	0.494
P(W/D)	0.360	0.365	0.331	0.331	0.336	0.310	0.303	0.322	0.254	0.210	0.340	0.339
ALPHA	0.755	0.683	0.747	0.708	0.673	0.741	0.695	0.705	0.672	0.709	0.788	0.673
BETA	0.232	0.294	0.323	0.333	0.372	0.337	0.386	0.399	0.556	0.462	0.312	0.358
BUFFALO, NY												
P(W/W)	0.704	0.658	0.613	0.595	0.483	0.397	0.363	0.446	0.480	0.555	0.630	0.699
P(W/D)	0.578	0.485	0.421	0.409	0.339	0.276	0.283	0.300	0.270	0.239	0.412	0.533
ALPHA	0.779	0.728	0.752	0.783	0.757	0.785	0.719	0.754	0.728	0.711	0.824	0.751
BETA	0.188	0.203	0.236	0.270	0.316	0.307	0.419	0.461	0.407	0.374	0.287	0.205
NEW YORK, NY												
P(W/W)	0.464	0.446	0.466	0.471	0.443	0.416	0.381	0.358	0.399	0.396	0.479	0.473
P(W/D)	0.302	0.296	0.325	0.354	0.314	0.271	0.245	0.297	0.217	0.191	0.283	0.299
ALPHA	0.739	0.671	0.683	0.650	0.664	0.765	0.627	0.583	0.667	0.608	0.683	0.658
BETA	0.328	0.492	0.509	0.494	0.413	0.380	0.628	0.768	0.579	0.682	0.514	0.481
SYRACUSE, NY												
P(W/W)	0.655	0.657	0.631	0.583	0.510	0.413	0.445	0.399	0.467	0.532	0.608	0.674
P(W/D)	0.494	0.487	0.415	0.388	0.350	0.301	0.284	0.308	0.262	0.266	0.425	0.561
ALPHA	0.893	0.778	0.736	0.800	0.783	0.735	0.715	0.722	0.805	0.824	0.806	0.840
BETA	0.161	0.222	0.244	0.267	0.280	0.378	0.417	0.479	0.325	0.324	0.256	0.186
NORTH PLATTE, NE												
P(W/W)	0.292	0.377	0.344	0.448	0.498	0.453	0.377	0.314	0.435	0.351	0.309	0.268
P(W/D)	0.126	0.151	0.167	0.179	0.255	0.273	0.270	0.227	0.154	0.117	0.108	0.112
ALPHA	0.845	0.750	0.731	0.683	0.700	0.635	0.769	0.676	0.705	0.704	0.813	0.785
BETA	0.094	0.137	0.190	0.343	0.466	0.640	0.401	0.388	0.408	0.282	0.131	0.126
SCOTTSELUFF, NE												
P(W/W)	0.326	0.396	0.390	0.474	0.555	0.529	0.335	0.323	0.446	0.363	0.286	0.354
P(W/D)	0.122	0.133	0.192	0.189	0.269	0.312	0.240	0.171	0.147	0.112	0.112	0.129
ALPHA	0.998	0.998	0.877	0.858	0.715	0.699	0.676	0.789	0.600	0.720	0.868	0.998
BETA	0.069	0.065	0.114	0.196	0.343	0.398	0.334	0.184	0.279	0.233	0.100	0.084

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ASHEVILLE, NC	P(W/W)	0.448	0.507	0.519	0.520	0.535	0.498	0.551	0.542	0.532	0.582	0.450	0.492
	P(W/D)	0.265	0.302	0.344	0.296	0.265	0.296	0.358	0.279	0.184	0.158	0.221	0.239
	ALPHA	0.690	0.786	0.700	0.670	0.772	0.779	0.818	0.676	0.628	0.672	0.670	0.645
	BETA	0.378	0.382	0.445	0.452	0.319	0.398	0.282	0.491	0.630	0.485	0.425	0.435
CHARLOTTE, NC	P(W/W)	0.463	0.498	0.515	0.465	0.472	0.371	0.495	0.490	0.345	0.523	0.361	0.395
	P(W/D)	0.235	0.287	0.272	0.245	0.205	0.283	0.289	0.223	0.161	0.133	0.189	0.246
	ALPHA	0.752	0.900	0.728	0.751	0.844	0.766	0.679	0.695	0.652	0.688	0.765	0.634
	BETA	0.487	0.438	0.546	0.514	0.392	0.503	0.498	0.614	0.741	0.524	0.480	0.602
GREENSBORO, NC	P(W/W)	0.435	0.500	0.516	0.442	0.502	0.495	0.519	0.539	0.476	0.479	0.436	0.434
	P(W/D)	0.255	0.281	0.264	0.279	0.232	0.266	0.301	0.244	0.167	0.158	0.199	0.202
	ALPHA	0.739	0.819	0.803	0.725	0.721	0.646	0.694	0.643	0.535	0.562	0.697	0.713
	BETA	0.459	0.437	0.426	0.465	0.389	0.628	0.500	0.647	0.768	0.769	0.450	0.581
RALEIGH, NC	P(W/W)	0.416	0.508	0.465	0.433	0.442	0.459	0.521	0.480	0.431	0.400	0.418	0.425
	P(W/D)	0.251	0.258	0.261	0.247	0.247	0.236	0.264	0.243	0.147	0.150	0.201	0.204
	ALPHA	0.722	0.808	0.873	0.844	0.797	0.732	0.770	0.620	0.729	0.722	0.755	0.850
	BETA	0.485	0.454	0.390	0.405	0.428	0.541	0.571	0.813	0.643	0.592	0.473	0.434
BISMARCK, ND	P(W/W)	0.354	0.393	0.372	0.477	0.480	0.519	0.412	0.330	0.344	0.363	0.445	0.437
	P(W/D)	0.227	0.188	0.205	0.187	0.261	0.328	0.249	0.277	0.200	0.112	0.139	0.197
	ALPHA	0.998	0.935	0.803	0.704	0.698	0.673	0.690	0.626	0.755	0.822	0.828	0.998
	BETA	0.066	0.074	0.100	0.250	0.328	0.422	0.336	0.321	0.226	0.158	0.108	0.062
WILLISTON, ND	P(W/W)	0.409	0.374	0.349	0.397	0.469	0.480	0.396	0.297	0.383	0.364	0.393	0.469
	P(W/D)	0.227	0.204	0.206	0.187	0.189	0.322	0.240	0.205	0.176	0.119	0.155	0.169
	ALPHA	0.998	0.998	0.998	0.731	0.728	0.689	0.644	0.644	0.664	0.733	0.998	0.998
	BETA	0.071	0.077	0.065	0.251	0.287	0.360	0.345	0.326	0.274	0.179	0.081	0.067
NEWARK, NJ	P(W/W)	0.437	0.398	0.470	0.463	0.473	0.407	0.448	0.432	0.426	0.378	0.450	0.461
	P(W/D)	0.300	0.313	0.316	0.330	0.297	0.278	0.254	0.260	0.211	0.189	0.299	0.292
	ALPHA	0.781	0.763	0.704	0.738	0.719	0.736	0.630	0.616	0.600	0.691	0.720	0.738
	BETA	0.311	0.419	0.501	0.434	0.397	0.377	0.604	0.681	0.659	0.584	0.449	0.421
CLEVELAND, OH	P(W/W)	0.598	0.606	0.583	0.584	0.506	0.438	0.395	0.384	0.429	0.505	0.613	0.626
	P(W/D)	0.470	0.452	0.432	0.404	0.319	0.290	0.292	0.267	0.252	0.244	0.352	0.419
	ALPHA	0.702	0.781	0.780	0.811	0.794	0.769	0.639	0.691	0.823	0.775	0.748	0.762
	BETA	0.219	0.179	0.235	0.302	0.331	0.379	0.520	0.455	0.348	0.324	0.267	0.197
COLUMBUS, OH	P(W/W)	0.504	0.480	0.516	0.545	0.500	0.463	0.391	0.350	0.418	0.423	0.509	0.502
	P(W/D)	0.339	0.359	0.384	0.360	0.328	0.276	0.323	0.230	0.216	0.205	0.288	0.329
	ALPHA	0.683	0.757	0.664	0.788	0.754	0.733	0.720	0.822	0.766	0.879	0.740	0.739
	BETA	0.325	0.263	0.359	0.358	0.423	0.489	0.543	0.419	0.377	0.252	0.309	0.267

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS													
STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
TOLEDO, OH	P(W/W)	0.534	0.450	0.515	0.520	0.519	0.459	0.392	0.364	0.433	0.431	0.505	0.521
	P(W/D)	0.350	0.326	0.364	0.366	0.287	0.252	0.260	0.229	0.251	0.186	0.279	0.363
	ALPHA	0.656	0.752	0.724	0.745	0.802	0.763	0.716	0.737	0.755	0.674	0.759	0.640
	BETA	0.240	0.228	0.251	0.305	0.313	0.434	0.504	0.508	0.321	0.381	0.287	0.283
OKLAHOMA CITY, OK	P(W/W)	0.370	0.415	0.450	0.399	0.492	0.447	0.407	0.328	0.360	0.374	0.424	0.396
	P(W/D)	0.123	0.172	0.179	0.197	0.217	0.205	0.175	0.190	0.190	0.117	0.100	0.125
	ALPHA	0.703	0.744	0.669	0.660	0.632	0.664	0.707	0.696	0.608	0.638	0.616	0.644
	BETA	0.247	0.255	0.387	0.638	0.873	0.696	0.572	0.551	0.880	0.867	0.529	0.351
TULSA, OK	P(W/W)	0.404	0.438	0.414	0.461	0.483	0.413	0.422	0.326	0.399	0.427	0.392	0.422
	P(W/D)	0.146	0.184	0.205	0.231	0.260	0.217	0.186	0.171	0.193	0.133	0.146	0.165
	ALPHA	0.711	0.757	0.672	0.707	0.658	0.647	0.591	0.662	0.638	0.582	0.605	0.625
	BETA	0.301	0.307	0.494	0.630	0.662	0.757	0.909	0.662	0.816	0.912	0.547	0.382
BURNS, OR	P(W/W)	0.566	0.519	0.545	0.438	0.468	0.433	0.255	0.352	0.339	0.508	0.596	0.606
	P(W/D)	0.353	0.223	0.233	0.178	0.180	0.157	0.067	0.082	0.072	0.127	0.201	0.243
	ALPHA	0.910	0.890	0.998	0.927	0.986	0.930	0.868	0.792	0.657	0.738	0.998	0.897
	BETA	0.152	0.142	0.096	0.107	0.126	0.139	0.148	0.164	0.263	0.203	0.146	0.168
MEACHUM, OR	P(W/W)	0.737	0.729	0.713	0.663	0.610	0.556	0.299	0.536	0.521	0.633	0.721	0.716
	P(W/D)	0.484	0.331	0.311	0.291	0.270	0.216	0.080	0.100	0.129	0.194	0.298	0.371
	ALPHA	0.844	0.900	0.998	0.919	0.920	0.838	0.816	0.688	0.792	0.801	0.927	0.906
	BETA	0.279	0.232	0.184	0.210	0.192	0.224	0.172	0.269	0.304	0.307	0.272	0.281
MEDFORD, OR	P(W/W)	0.655	0.557	0.588	0.534	0.538	0.452	0.344	0.367	0.318	0.529	0.627	0.657
	P(W/D)	0.361	0.269	0.236	0.189	0.174	0.111	0.036	0.053	0.086	0.159	0.273	0.281
	ALPHA	0.703	0.608	0.876	0.946	0.791	0.985	0.579	0.998	0.724	0.678	0.692	0.654
	BETA	0.346	0.344	0.174	0.111	0.190	0.138	0.296	0.153	0.248	0.337	0.345	0.422
PENDLETON, OR	P(W/W)	0.571	0.535	0.485	0.434	0.452	0.364	0.232	0.391	0.383	0.462	0.521	0.551
	P(W/D)	0.353	0.247	0.250	0.249	0.179	0.163	0.067	0.078	0.108	0.174	0.275	0.369
	ALPHA	0.966	0.977	0.998	0.938	0.874	0.843	0.957	0.932	0.913	0.813	0.933	0.909
	BETA	0.134	0.111	0.100	0.108	0.163	0.145	0.096	0.111	0.149	0.156	0.139	0.119
SALEM, OR	P(W/W)	0.791	0.728	0.750	0.638	0.611	0.555	0.404	0.494	0.507	0.659	0.776	0.755
	P(W/D)	0.411	0.341	0.293	0.304	0.215	0.151	0.045	0.086	0.148	0.233	0.339	0.427
	ALPHA	0.866	0.763	0.964	0.867	0.998	0.776	0.826	0.829	0.722	0.866	0.833	0.827
	BETA	0.435	0.380	0.270	0.198	0.172	0.221	0.148	0.157	0.296	0.337	0.380	0.434
PORTLAND, OR	P(W/W)	0.802	0.697	0.726	0.634	0.619	0.561	0.386	0.585	0.497	0.684	0.775	0.752
	P(W/D)	0.425	0.357	0.344	0.309	0.236	0.188	0.071	0.082	0.172	0.232	0.324	0.443
	ALPHA	0.830	0.840	0.998	0.945	0.853	0.854	0.788	0.843	0.790	0.962	0.869	0.879
	BETA	0.369	0.303	0.211	0.177	0.196	0.207	0.144	0.224	0.239	0.269	0.343	0.352

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SEXT. SUMMIT, OR												
P(W/W)	0.774	0.689	0.712	0.604	0.602	0.476	0.212	0.426	0.489	0.632	0.719	0.745
P(W/D)	0.373	0.312	0.300	0.230	0.179	0.126	0.044	0.053	0.101	0.174	0.276	0.286
ALPHA	0.730	0.712	0.887	0.835	0.776	0.890	0.819	0.749	0.745	0.729	0.694	0.731
BETA	0.533	0.429	0.262	0.223	0.277	0.191	0.173	0.264	0.305	0.445	0.577	0.559
ROSWELL, NM												
P(W/W)	0.314	0.352	0.358	0.286	0.329	0.307	0.408	0.421	0.384	0.531	0.360	0.359
P(W/D)	0.063	0.097	0.072	0.056	0.091	0.117	0.197	0.173	0.125	0.078	0.053	0.070
ALPHA	0.830	0.858	0.810	0.740	0.641	0.612	0.664	0.683	0.593	0.596	0.768	0.779
BETA	0.196	0.160	0.170	0.233	0.274	0.330	0.330	0.331	0.367	0.432	0.176	0.183
PHILADELPHIA, PA												
P(W/W)	0.464	0.393	0.438	0.459	0.437	0.395	0.372	0.421	0.407	0.381	0.441	0.478
P(W/D)	0.268	0.295	0.298	0.313	0.275	0.272	0.246	0.256	0.185	0.171	0.257	0.255
ALPHA	0.749	0.757	0.811	0.759	0.760	0.585	0.664	0.668	0.613	0.577	0.735	0.673
BETA	0.342	0.388	0.442	0.405	0.365	0.684	0.665	0.615	0.746	0.678	0.467	0.502
PITTSBURGH, PA												
P(W/W)	0.596	0.606	0.582	0.526	0.516	0.486	0.400	0.360	0.391	0.443	0.565	0.608
P(W/D)	0.443	0.414	0.451	0.393	0.311	0.304	0.317	0.267	0.219	0.255	0.328	0.451
ALPHA	0.751	0.836	0.731	0.847	0.772	0.733	0.728	0.651	0.723	0.695	0.841	0.765
BETA	0.225	0.197	0.303	0.312	0.369	0.429	0.465	0.530	0.402	0.357	0.215	0.188
PROVIDENCE, RI												
P(W/W)	0.422	0.461	0.453	0.484	0.445	0.465	0.354	0.372	0.400	0.405	0.495	0.450
P(W/D)	0.336	0.323	0.321	0.298	0.301	0.297	0.256	0.304	0.211	0.208	0.292	0.329
ALPHA	0.650	0.637	0.657	0.658	0.670	0.650	0.655	0.589	0.636	0.590	0.626	0.645
BETA	0.477	0.568	0.562	0.549	0.451	0.371	0.491	0.640	0.683	0.735	0.633	0.592
CHARLESTON, SC												
P(W/W)	0.438	0.448	0.478	0.377	0.443	0.569	0.539	0.520	0.481	0.472	0.383	0.404
P(W/D)	0.244	0.268	0.265	0.194	0.205	0.259	0.381	0.310	0.231	0.134	0.171	0.222
ALPHA	0.702	0.760	0.707	0.710	0.628	0.603	0.710	0.677	0.758	0.576	0.657	0.678
BETA	0.478	0.506	0.604	0.551	0.749	0.941	0.840	0.753	0.684	0.894	0.437	0.501
COLUMBIA, SC												
P(W/W)	0.492	0.477	0.481	0.449	0.417	0.446	0.515	0.502	0.462	0.529	0.392	0.416
P(W/D)	0.227	0.283	0.262	0.227	0.206	0.246	0.290	0.260	0.162	0.112	0.168	0.229
ALPHA	0.649	0.731	0.758	0.674	0.758	0.812	0.672	0.637	0.559	0.578	0.723	0.737
BETA	0.612	0.559	0.593	0.634	0.581	0.475	0.676	0.837	1.031	0.824	0.473	0.507
HURON, SD												
P(W/W)	0.333	0.445	0.379	0.457	0.485	0.465	0.358	0.360	0.368	0.433	0.368	0.331
P(W/D)	0.171	0.167	0.189	0.252	0.263	0.324	0.261	0.254	0.176	0.114	0.134	0.169
ALPHA	0.998	0.707	0.712	0.682	0.616	0.652	0.664	0.615	0.705	0.611	0.699	0.761
BETA	0.055	0.181	0.185	0.300	0.426	0.514	0.388	0.391	0.322	0.419	0.175	0.127
RAPID CITY, SD												
P(W/W)	0.370	0.503	0.444	0.518	0.519	0.557	0.394	0.338	0.362	0.360	0.382	0.411
P(W/D)	0.156	0.200	0.222	0.233	0.306	0.317	0.239	0.208	0.167	0.103	0.157	0.155
ALPHA	0.998	0.988	0.815	0.776	0.674	0.713	0.622	0.707	0.757	0.709	0.830	0.998
BETA	0.064	0.088	0.130	0.263	0.346	0.378	0.390	0.251	0.250	0.201	0.098	0.070

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
CHATTANOOGA, TN	P(W/W)	0.513	0.517	0.489	0.493	0.473	0.465	0.541	0.457	0.443	0.489	0.453
	P(W/D)	0.268	0.295	0.289	0.270	0.228	0.264	0.263	0.240	0.201	0.154	0.263
	ALPHA	0.727	0.769	0.671	0.719	0.794	0.721	0.801	0.679	0.632	0.738	0.718
	BETA	0.623	0.612	0.725	0.635	0.457	0.464	0.481	0.502	0.732	0.519	0.733
KNOXVILLE, TN	P(W/W)	0.506	0.531	0.506	0.528	0.473	0.444	0.494	0.422	0.477	0.503	0.466
	P(W/D)	0.317	0.329	0.327	0.294	0.253	0.291	0.304	0.257	0.191	0.170	0.289
	ALPHA	0.747	0.774	0.737	0.759	0.916	0.720	0.778	0.681	0.732	0.729	0.664
	BETA	0.489	0.517	0.550	0.442	0.336	0.528	0.452	0.493	0.478	0.439	0.644
MEMPHIS, TN	P(W/W)	0.472	0.455	0.491	0.431	0.482	0.469	0.395	0.397	0.424	0.324	0.439
	P(W/D)	0.246	0.294	0.270	0.295	0.184	0.200	0.241	0.205	0.154	0.146	0.259
	ALPHA	0.645	0.753	0.755	0.729	0.717	0.755	0.698	0.620	0.658	0.657	0.686
	BETA	0.713	0.619	0.605	0.784	0.806	0.535	0.652	0.763	0.777	0.595	0.684
NASHVILLE, TN	P(W/W)	0.484	0.521	0.500	0.476	0.485	0.516	0.422	0.386	0.462	0.408	0.493
	P(W/D)	0.274	0.299	0.280	0.323	0.248	0.238	0.272	0.214	0.174	0.161	0.249
	ALPHA	0.655	0.835	0.705	0.763	0.743	0.718	0.705	0.751	0.647	0.738	0.805
	BETA	0.616	0.488	0.652	0.512	0.553	0.533	0.524	0.489	0.679	0.456	0.568
ABILENE, TX	P(W/W)	0.333	0.402	0.318	0.453	0.459	0.491	0.357	0.303	0.415	0.337	0.388
	P(W/D)	0.102	0.135	0.111	0.149	0.179	0.115	0.097	0.136	0.149	0.136	0.089
	ALPHA	0.603	0.796	0.864	0.741	0.676	0.633	0.637	0.587	0.609	0.611	0.707
	BETA	0.425	0.249	0.241	0.565	0.730	0.811	0.858	0.675	0.707	0.663	0.295
AMARILLO, TX	P(W/W)	0.313	0.353	0.326	0.376	0.443	0.448	0.464	0.373	0.303	0.477	0.419
	P(W/D)	0.081	0.117	0.121	0.107	0.212	0.207	0.203	0.203	0.147	0.090	0.092
	ALPHA	0.654	0.748	0.748	0.687	0.575	0.582	0.615	0.639	0.572	0.664	0.834
	BETA	0.214	0.173	0.240	0.352	0.560	0.753	0.546	0.560	0.564	0.479	0.237
AUSTIN, TX	P(W/W)	0.444	0.479	0.393	0.397	0.418	0.478	0.312	0.430	0.445	0.390	0.479
	P(W/D)	0.174	0.205	0.179	0.190	0.197	0.117	0.101	0.115	0.172	0.143	0.144
	ALPHA	0.601	0.555	0.632	0.613	0.571	0.611	0.547	0.643	0.637	0.550	0.556
	BETA	0.366	0.644	0.368	0.688	0.841	0.993	0.701	0.653	0.805	1.048	0.534
BROWNSVILLE, TX	P(W/W)	0.459	0.485	0.413	0.380	0.433	0.527	0.387	0.484	0.540	0.420	0.492
	P(W/D)	0.148	0.158	0.097	0.087	0.094	0.107	0.093	0.138	0.226	0.160	0.138
	ALPHA	0.614	0.469	0.646	0.517	0.535	0.586	0.615	0.628	0.579	0.507	0.559
	BETA	0.324	0.529	0.205	0.636	0.978	0.698	0.382	0.601	0.904	1.074	0.311
CORPUS CHRISTI, TX	P(W/W)	0.456	0.482	0.327	0.309	0.408	0.422	0.371	0.448	0.529	0.438	0.431
	P(W/D)	0.171	0.165	0.138	0.130	0.153	0.130	0.104	0.113	0.219	0.142	0.136
	ALPHA	0.483	0.547	0.635	0.453	0.581	0.560	0.597	0.565	0.593	0.553	0.544
	BETA	0.435	0.484	0.238	0.882	0.775	0.961	0.585	0.991	1.029	0.862	0.419

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
DALLAS, TX												
P(W/W)	0.431	0.456	0.404	0.471	0.447	0.392	0.348	0.298	0.440	0.320	0.447	0.435
P(W/D)	0.153	0.195	0.203	0.196	0.202	0.146	0.105	0.139	0.143	0.126	0.134	0.131
ALPHA	0.750	0.653	0.612	0.673	0.632	0.713	0.568	0.581	0.667	0.525	0.652	0.661
BETA	0.358	0.448	0.586	0.924	0.824	0.659	0.703	0.655	0.882	1.281	0.704	0.589
ELPASO, TX												
P(W/W)	0.368	0.352	0.288	0.235	0.257	0.250	0.320	0.441	0.376	0.328	0.320	0.368
P(W/D)	0.060	0.067	0.075	0.046	0.043	0.087	0.229	0.168	0.093	0.077	0.064	0.080
ALPHA	0.988	0.911	0.817	0.658	0.709	0.694	0.645	0.716	0.558	0.827	0.890	0.976
BETA	0.107	0.179	0.165	0.188	0.208	0.279	0.338	0.222	0.510	0.214	0.146	0.117
GALVESTON, TX												
P(W/W)	0.383	0.436	0.341	0.311	0.407	0.468	0.453	0.462	0.574	0.424	0.425	0.436
P(W/D)	0.232	0.251	0.186	0.172	0.141	0.141	0.162	0.206	0.175	0.131	0.156	0.221
ALPHA	0.640	0.622	0.567	0.551	0.589	0.580	0.609	0.635	0.523	0.727	0.613	0.691
BETA	0.509	0.566	0.513	0.806	0.838	1.029	0.853	0.805	1.357	0.629	0.718	0.651
HOUSTON, TX												
P(W/W)	0.407	0.492	0.369	0.410	0.440	0.478	0.443	0.464	0.541	0.508	0.410	0.473
P(W/D)	0.253	0.237	0.218	0.212	0.189	0.156	0.214	0.219	0.186	0.135	0.205	0.232
ALPHA	0.558	0.564	0.507	0.485	0.565	0.585	0.594	0.581	0.645	0.545	0.584	0.626
BETA	0.615	0.754	0.574	0.899	1.085	1.112	0.710	0.747	0.843	1.034	0.774	0.663
SAN ANTONIO, TX												
P(W/W)	0.446	0.494	0.409	0.387	0.403	0.417	0.319	0.378	0.486	0.445	0.448	0.432
P(W/D)	0.180	0.195	0.166	0.179	0.195	0.123	0.088	0.115	0.167	0.135	0.140	0.158
ALPHA	0.521	0.604	0.502	0.545	0.592	0.562	0.495	0.566	0.689	0.600	0.577	0.606
BETA	0.392	0.453	0.420	0.584	0.719	0.947	0.841	0.769	0.650	0.762	0.593	0.343
TEMPLE, TX												
P(W/W)	0.507	0.451	0.399	0.477	0.448	0.407	0.333	0.365	0.448	0.421	0.547	0.482
P(W/D)	0.149	0.213	0.176	0.178	0.193	0.133	0.079	0.118	0.161	0.125	0.127	0.151
ALPHA	0.659	0.735	0.713	0.680	0.630	0.704	0.705	0.584	0.686	0.488	0.633	0.590
BETA	0.428	0.454	0.360	0.663	0.816	0.677	0.593	0.831	0.695	1.308	0.616	0.563
WACO, TX												
P(W/W)	0.397	0.424	0.417	0.414	0.429	0.416	0.344	0.386	0.455	0.337	0.425	0.414
P(W/D)	0.148	0.210	0.166	0.203	0.188	0.138	0.072	0.111	0.138	0.123	0.142	0.133
ALPHA	0.650	0.744	0.676	0.573	0.612	0.651	0.639	0.711	0.706	0.626	0.707	0.677
BETA	0.415	0.387	0.446	0.838	1.014	0.699	0.493	0.546	0.776	0.858	0.580	0.470
MILFORD, UT												
P(W/W)	0.364	0.400	0.497	0.442	0.412	0.403	0.344	0.392	0.313	0.408	0.364	0.441
P(W/D)	0.151	0.200	0.156	0.153	0.099	0.079	0.119	0.147	0.100	0.078	0.111	0.131
ALPHA	0.863	0.990	0.981	0.920	0.998	0.770	0.771	0.890	0.721	0.848	0.889	0.956
BETA	0.122	0.105	0.133	0.159	0.133	0.185	0.154	0.112	0.267	0.175	0.169	0.112
SALT LAKE CITY, UT												
P(W/W)	0.479	0.397	0.463	0.525	0.487	0.500	0.315	0.373	0.389	0.461	0.434	0.497
P(W/D)	0.226	0.263	0.236	0.239	0.165	0.139	0.104	0.139	0.111	0.108	0.170	0.230
ALPHA	0.854	0.881	0.911	0.799	0.853	0.734	0.635	0.638	0.696	0.702	0.821	0.879
BETA	0.165	0.169	0.178	0.276	0.206	0.249	0.299	0.264	0.219	0.265	0.212	0.170

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
NORFOLK, VA	P(W/W)	0.477	0.470	0.429	0.442	0.445	0.435	0.535	0.484	0.478	0.453	0.412	0.405
	P(W/D)	0.246	0.289	0.316	0.301	0.242	0.228	0.266	0.272	0.184	0.174	0.223	0.226
	ALPHA	0.728	0.757	0.744	0.782	0.727	0.645	0.704	0.608	0.519	0.619	0.666	0.823
	BETA	0.493	0.446	0.426	0.331	0.477	0.617	0.647	0.934	1.044	0.713	0.508	0.452
RICHMOND, VA	P(W/W)	0.474	0.446	0.460	0.477	0.490	0.472	0.448	0.472	0.424	0.382	0.396	0.402
	P(W/D)	0.252	0.266	0.284	0.253	0.243	0.226	0.271	0.249	0.187	0.172	0.237	0.215
	ALPHA	0.770	0.843	0.816	0.825	0.734	0.646	0.642	0.607	0.642	0.623	0.620	0.751
	BETA	0.374	0.431	0.393	0.353	0.419	0.641	0.802	0.881	0.661	0.743	0.642	0.553
OLYMPIA, WA	P(W/W)	0.816	0.766	0.758	0.698	0.586	0.542	0.489	0.571	0.601	0.707	0.787	0.788
	P(W/D)	0.452	0.344	0.321	0.276	0.185	0.194	0.079	0.106	0.160	0.267	0.349	0.455
	ALPHA	0.848	0.862	0.998	0.917	0.998	0.796	0.998	0.753	0.848	0.863	0.800	0.851
	BETA	0.482	0.392	0.264	0.236	0.171	0.194	0.149	0.262	0.289	0.419	0.530	0.462
SPOKANE, WA	P(W/W)	0.648	0.600	0.542	0.409	0.469	0.400	0.240	0.388	0.395	0.479	0.584	0.621
	P(W/D)	0.361	0.269	0.239	0.225	0.202	0.200	0.099	0.121	0.154	0.184	0.278	0.386
	ALPHA	0.955	0.998	0.956	0.933	0.889	0.702	0.878	0.746	0.824	0.910	0.903	0.887
	BETA	0.181	0.143	0.139	0.135	0.161	0.242	0.131	0.173	0.135	0.168	0.199	0.178
STAMPEDE PASS, WA	P(W/W)	0.867	0.822	0.807	0.774	0.684	0.714	0.530	0.649	0.638	0.723	0.807	0.858
	P(W/D)	0.457	0.418	0.388	0.379	0.323	0.284	0.161	0.209	0.251	0.330	0.361	0.442
	ALPHA	0.858	0.772	0.889	0.809	0.846	0.785	0.822	0.775	0.701	0.874	0.824	0.797
	BETA	0.698	0.680	0.486	0.458	0.285	0.307	0.217	0.282	0.543	0.596	0.763	0.775
YAKIMA, WA	P(W/W)	0.553	0.574	0.423	0.360	0.337	0.290	0.182	0.296	0.245	0.368	0.470	0.493
	P(W/D)	0.229	0.126	0.126	0.110	0.126	0.124	0.044	0.069	0.073	0.114	0.188	0.229
	ALPHA	0.811	0.873	0.998	0.988	0.977	0.807	0.902	0.998	0.872	0.878	0.974	0.809
	BETA	0.175	0.134	0.118	0.119	0.105	0.177	0.106	0.093	0.127	0.117	0.131	0.161
WALLA WALLA, WA	P(W/W)	0.592	0.560	0.486	0.457	0.451	0.336	0.306	0.328	0.415	0.454	0.539	0.548
	P(W/D)	0.377	0.262	0.259	0.240	0.197	0.181	0.054	0.085	0.119	0.200	0.304	0.370
	ALPHA	0.878	0.880	0.897	0.878	0.766	0.780	0.671	0.778	0.860	0.702	0.855	0.822
	BETA	0.174	0.146	0.148	0.167	0.229	0.197	0.208	0.201	0.196	0.235	0.180	0.174
CHARLESTON, WV	P(W/W)	0.541	0.551	0.577	0.548	0.550	0.500	0.466	0.473	0.473	0.464	0.514	0.521
	P(W/D)	0.383	0.395	0.397	0.395	0.314	0.264	0.369	0.249	0.213	0.222	0.279	0.384
	ALPHA	0.741	0.730	0.761	0.828	0.747	0.827	0.680	0.683	0.780	0.693	0.850	0.746
	BETA	0.315	0.344	0.364	0.304	0.365	0.351	0.598	0.547	0.398	0.380	0.289	0.300
GREEN BAY, WI	P(W/W)	0.400	0.393	0.495	0.493	0.471	0.487	0.398	0.405	0.426	0.467	0.425	0.420
	P(W/D)	0.282	0.217	0.262	0.271	0.339	0.298	0.273	0.267	0.293	0.196	0.223	0.286
	ALPHA	0.821	0.822	0.808	0.781	0.718	0.734	0.688	0.787	0.728	0.724	0.754	0.825
	BETA	0.130	0.159	0.180	0.346	0.362	0.407	0.509	0.342	0.454	0.365	0.252	0.150

TABLE A1. CONTINUED.

RAINFALL GENERATION PARAMETERS

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
LACROSSE, WI	P(W/W)	0.320	0.410	0.425	0.406	0.515	0.448	0.359	0.412	0.465	0.403	0.414
	P(W/D)	0.233	0.161	0.272	0.274	0.296	0.308	0.287	0.245	0.242	0.204	0.178
	ALPHA	0.838	0.778	0.723	0.791	0.862	0.728	0.732	0.816	0.722	0.793	0.662
	BETA	0.127	0.158	0.264	0.362	0.356	0.554	0.555	0.437	0.516	0.345	0.310
MADISON, WI	P(W/W)	0.392	0.409	0.468	0.487	0.522	0.452	0.380	0.369	0.432	0.471	0.419
	P(W/D)	0.284	0.204	0.292	0.322	0.287	0.297	0.282	0.256	0.245	0.204	0.219
	ALPHA	0.794	0.751	0.783	0.709	0.713	0.695	0.655	0.689	0.631	0.688	0.654
	BETA	0.137	0.170	0.220	0.350	0.408	0.568	0.616	0.544	0.549	0.413	0.329
MILWAUKEE, WI	P(W/W)	0.481	0.449	0.466	0.506	0.463	0.509	0.398	0.410	0.464	0.475	0.414
	P(W/D)	0.288	0.260	0.299	0.349	0.313	0.285	0.288	0.226	0.240	0.206	0.243
	ALPHA	0.661	0.756	0.711	0.759	0.800	0.670	0.635	0.650	0.638	0.670	0.692
	BETA	0.208	0.167	0.281	0.323	0.297	0.486	0.584	0.525	0.472	0.390	0.323
CHEYENNE, WY	P(W/W)	0.360	0.414	0.489	0.527	0.597	0.488	0.425	0.373	0.444	0.386	0.398
	P(W/D)	0.125	0.176	0.225	0.206	0.251	0.282	0.293	0.255	0.159	0.123	0.131
	ALPHA	0.998	0.924	0.833	0.864	0.749	0.689	0.742	0.737	0.735	0.794	0.942
	BETA	0.064	0.071	0.117	0.159	0.283	0.302	0.219	0.222	0.214	0.191	0.091

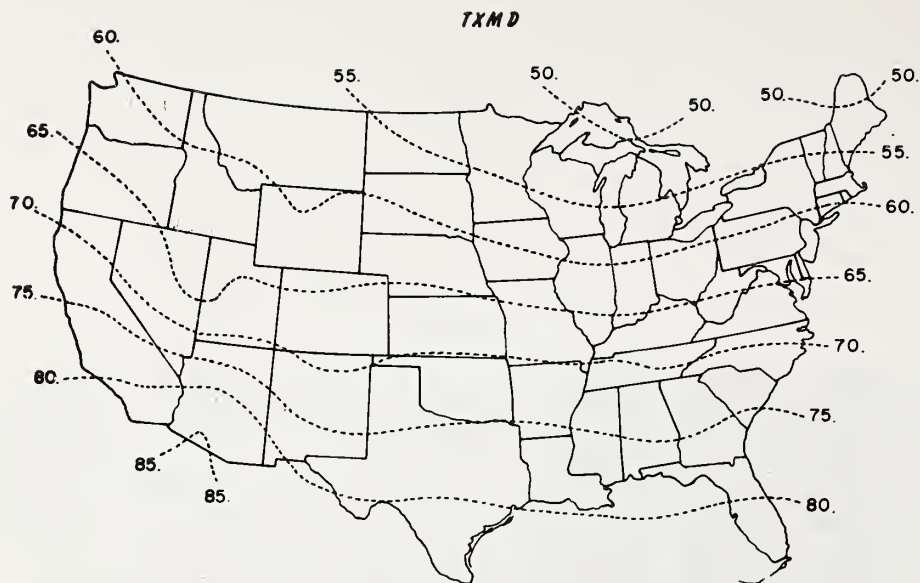


Figure A1. Distribution of the mean of t_{\max} for dry days (TXMD), °F.

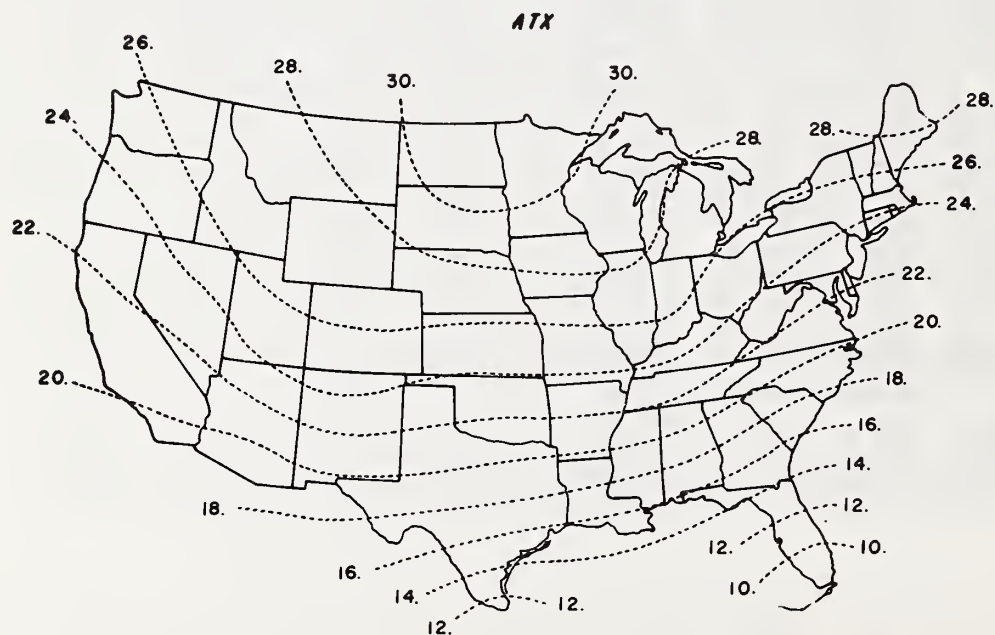


Figure A2. Distribution of the amplitude to t_{\max} for wet or dry days (ATX), °F.

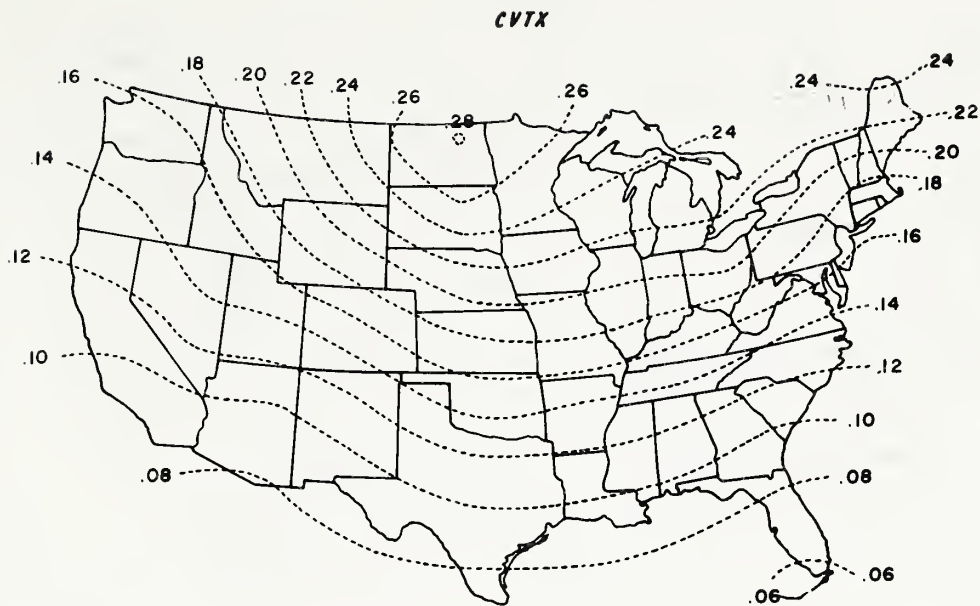


Figure A3. Distribution of the mean of the coefficient of variation of t_{\max} for wet or dry days (CVTX).

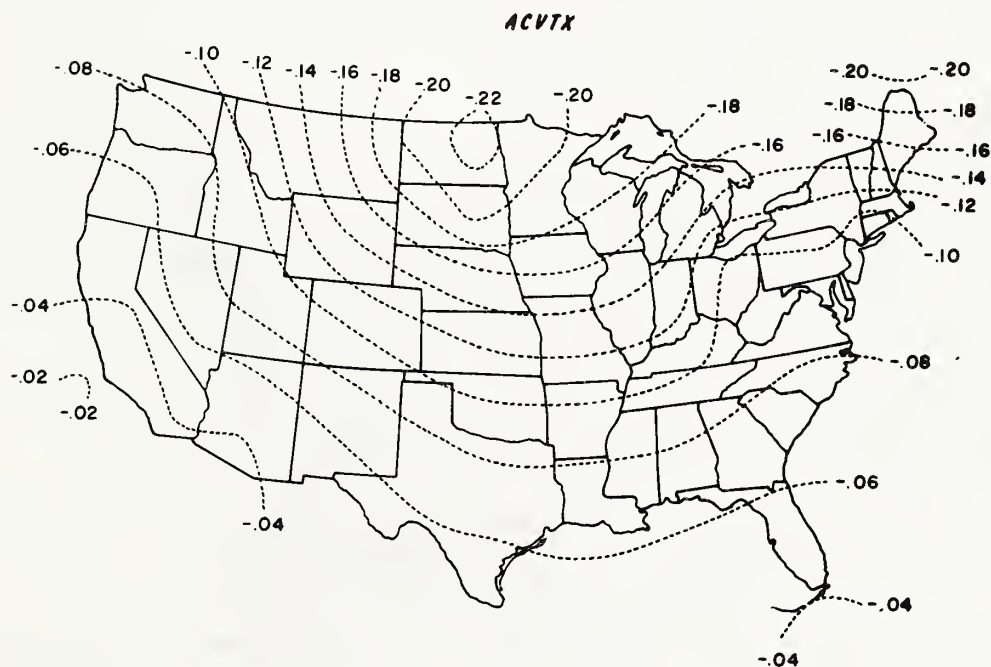


Figure A4. Distribution of the amplitude of the coefficient of variation of t_{\max} for wet or dry days (ACVTX).

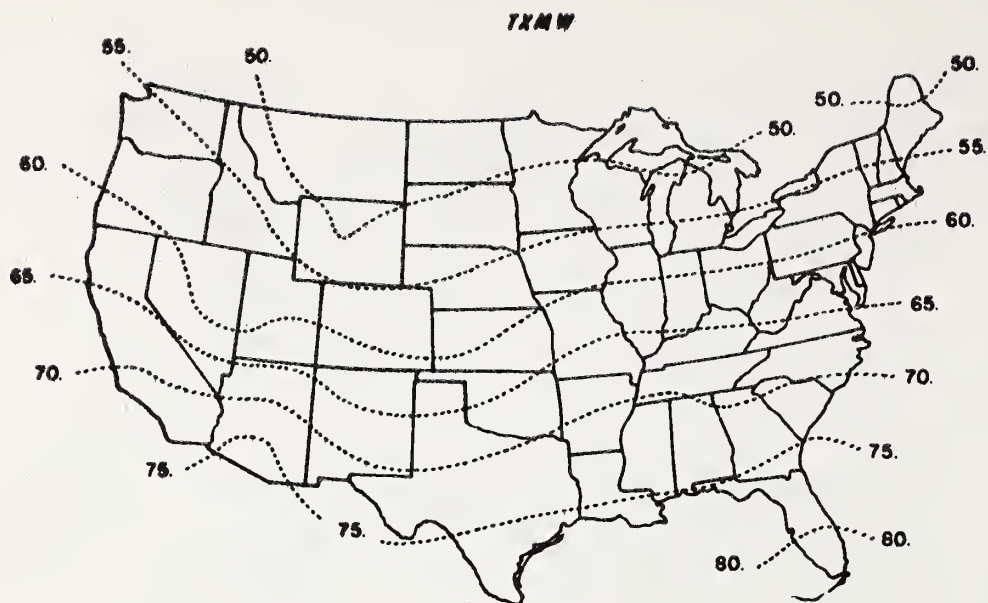


Figure A5. Distribution of the mean of t_{\max} for wet days (TXMW), °F.

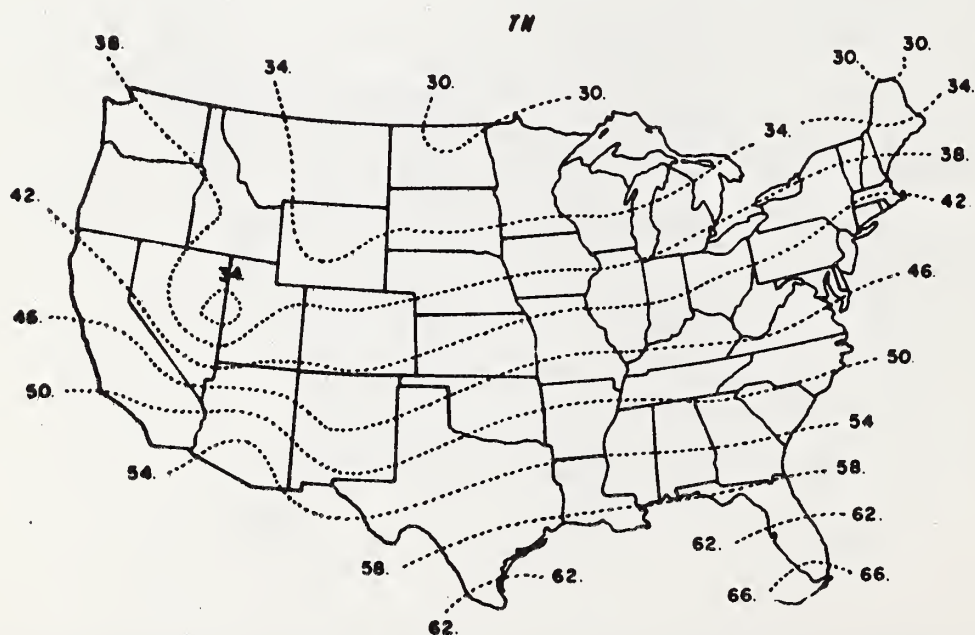


Figure A6. Distribution of the mean of t_{\min} for wet or dry days (TN), °F.

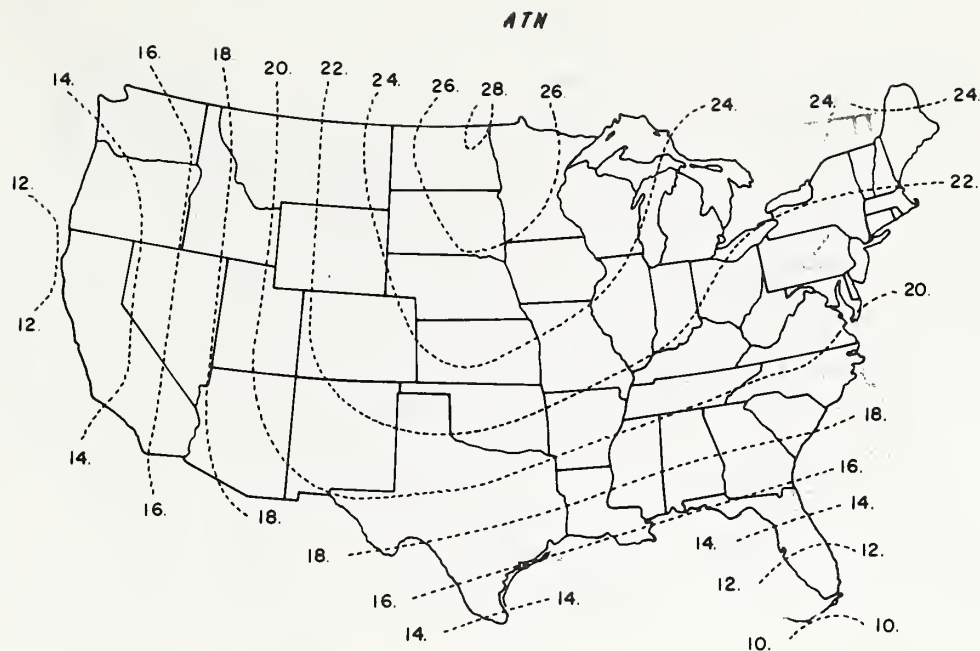


Figure A7. Distribution of the amplitude of t_{\min} for wet or dry days (ATN), °F.

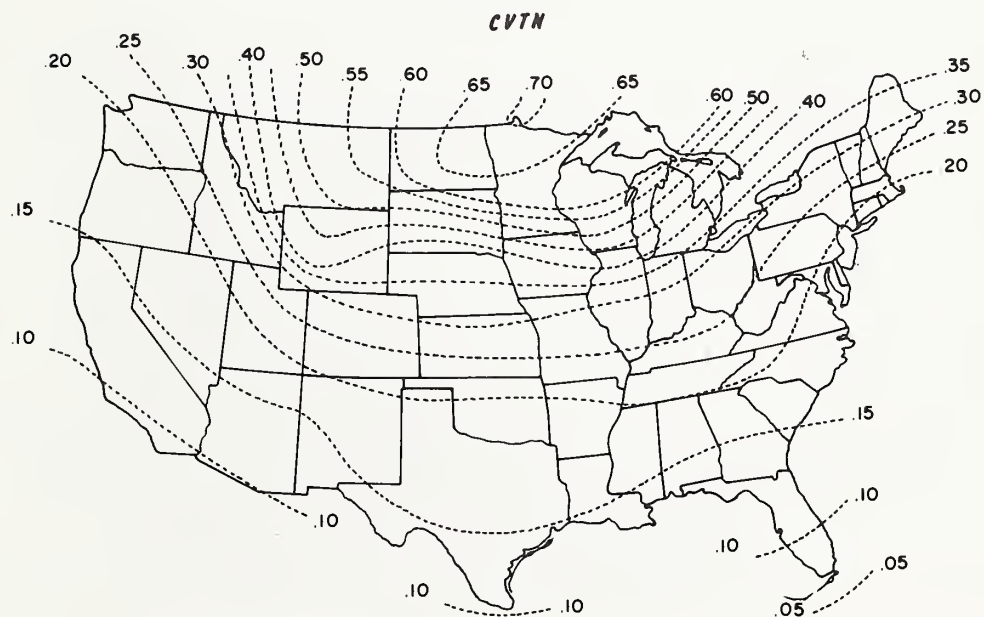


Figure A8. Distribution of the mean of the coefficient of variation of t_{\min} for wet or dry days (CVTN).

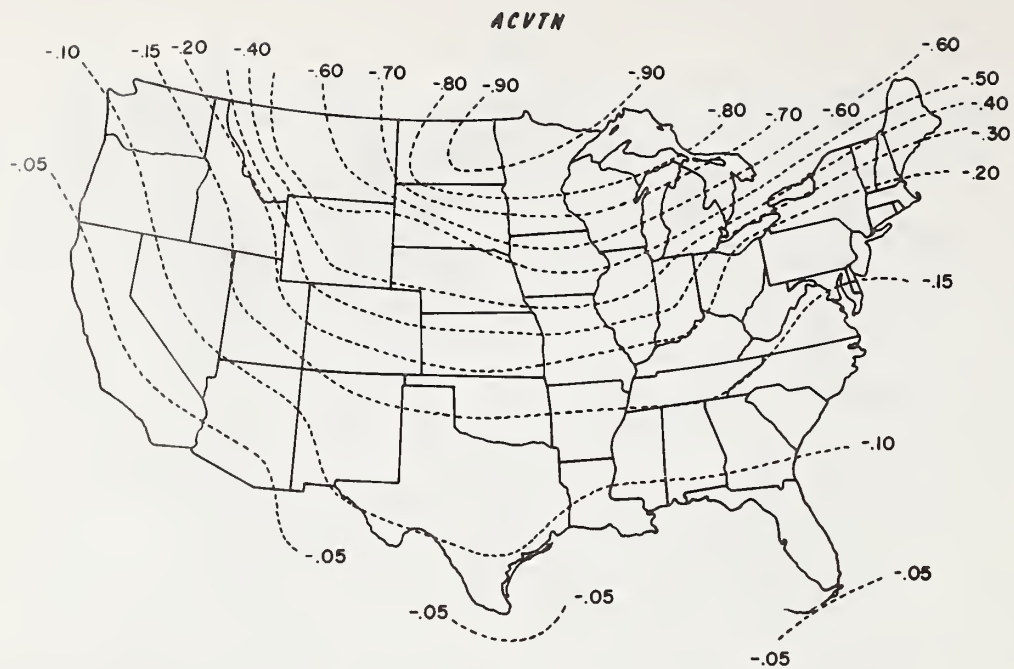


Figure A9. Distribution of the amplitude of the coefficient of variation of t_{\min} for wet or dry days (ACVTN).

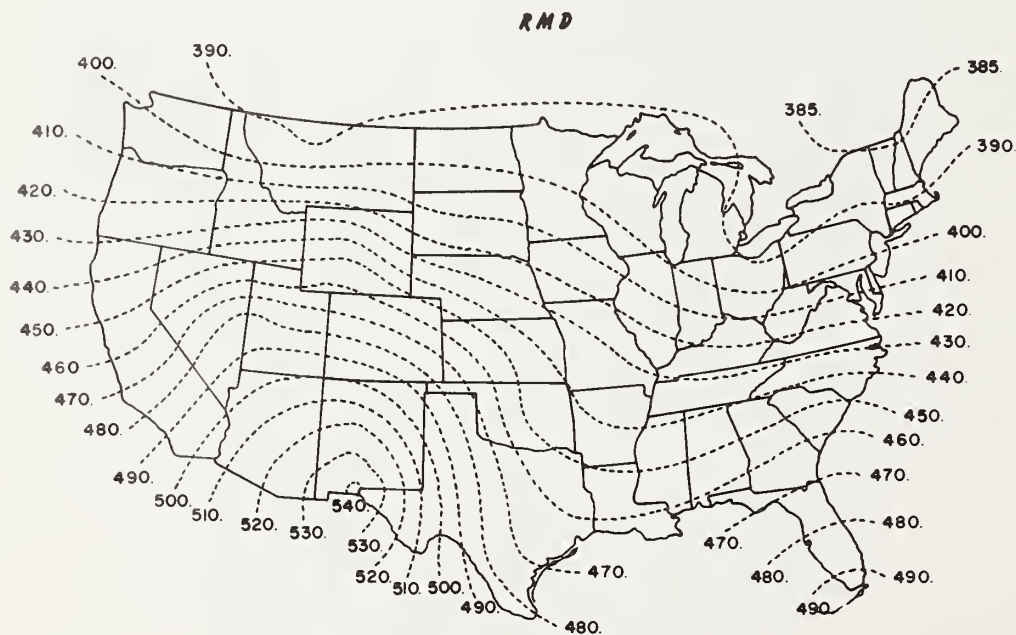


Figure A10. Distribution of the mean of r for dry days (RMD), ly.

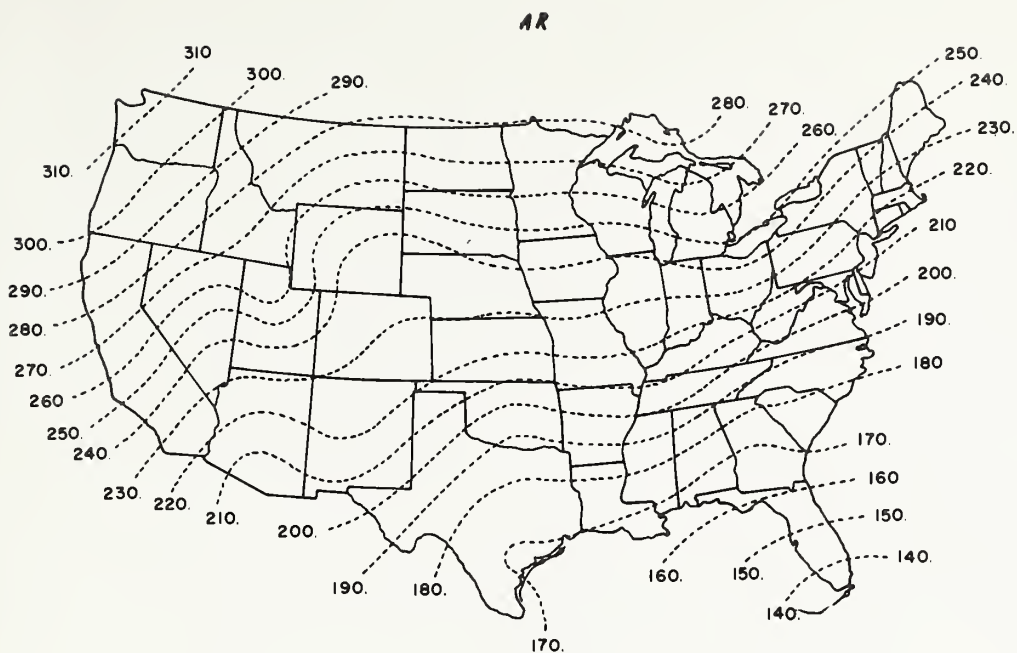


Figure A11. Distribution of the amplitude of r for dry days (AR), ly.

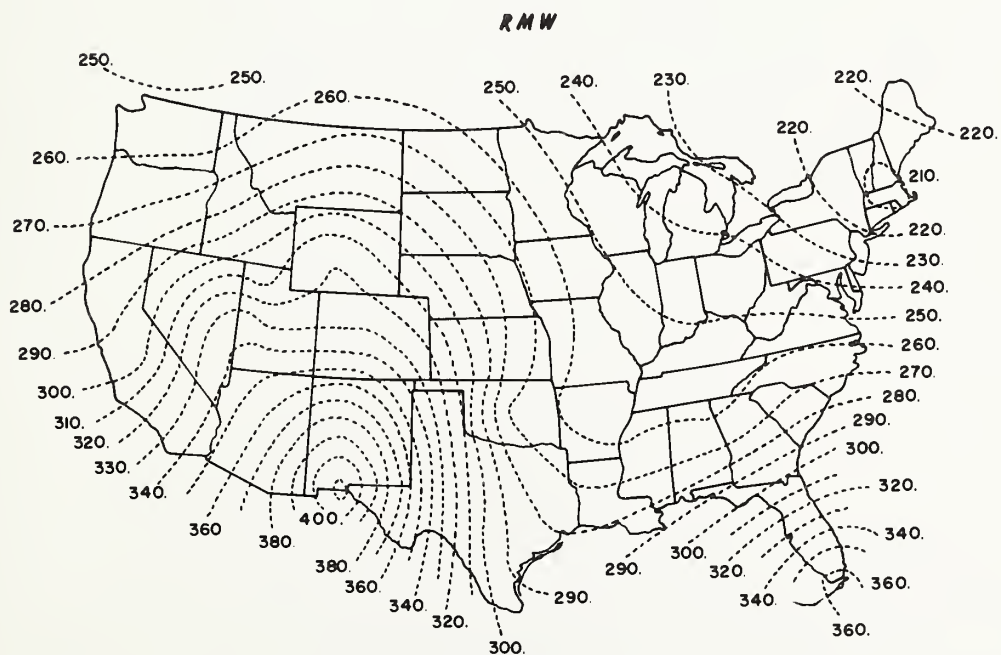


Figure A12. Distribution of the mean of r for wet days (RMW), ly.

APPENDIX B
Input Data for WGEN

Table B1. Description of order, format, and source of input for WGEN

<u>Input no.</u>	<u>Variable name</u>	<u>Description</u>	<u>Format</u>	<u>Source</u>
1	ACOM(I)	Up to 80 characters of user comments	20A4	User supplied
2	NYRS	Number of years of data to be generated	I5	User supplied
	KGEN	Generation option code 1 if p , t_{\max} , t_{\min} and r to be generated 2 if actual p to be used	I5	User supplied
	ALAT	Station latitude, deg	F5.0	User supplied
	KTCF	Temperature correction factor code 0 if no temperature correction 1 if some correction factor for maximum and minimum temperatures 2 if independent correction factors for maximum and minimum temperatures	I5	User supplied
	KRFC	Precipitation correction factor code 0 if no precipitation correction 1 if precipitation to be corrected	I5	User supplied
-----If KGEN = 2, skip to Input No. 7-----				
3	PWW(I)	Monthly probability of wet day given wet on previous day	12F6.0	Table A1
4	PWD(I)	Monthly probability of wet day given dry on previous day	12F6.0	Table A1
5	ALPHA(I)	Monthly values of gamma distribution shape parameter	12F6.0	Table A1
6	BETA(I)	Monthly values of gamma distribution scale parameter	12F6.0	Table A1

Table B1. Continued.

<u>Input no.</u>	<u>Variable name</u>	<u>Description</u>	<u>Format</u>	<u>Source</u>
7	TXMD	Mean of t_{\max} (dry)	F8.0	Figure A1
	ATX	Amplitude of t_{\max} (wet or dry)	F8.0	Figure A2
	CVTX	Mean of coef. of var. of t_{\max} (wet or dry)	F8.0	Figure A3
	ACVTX	Amplitude of coef. of var. of t_{\max} (wet or dry)	F8.0	Figure A4
8	TXMW	Mean of t_{\max} (wet)	F8.0	Figure A5
9	TN	Mean of t_{\min} (wet or dry)	F8.0	Figure A6
	ATN	Amplitude of t_{\min} (wet or dry)	F8.0	Figure A7
	CVTN	Mean of coef. of var. of t_{\min} (wet or dry)	F8.0	Figure A8
	ACVTN	Amplitude of coef. of var. of t_{\min} (wet or dry)	F8.0	Figure A9
10	RMD	Mean of r (dry)	F8.0	Figure A10
	AR	Amplitude of r (wet or dry)	F8.0	Figure A11
11	RMW	Mean of r (wet)	F8.0	Figure A12
-----If KTCF = 0, skip to Input No. 15-----				
-----If KTCF = 2, skip to Input No. 13-----				
12	TM(I)	Monthly values of actual mean temperature (°F)	12F6.0	User supplied
13	TTMAX(I)	Monthly values of actual mean maximum temperature (°F)	12F6.0	User supplied
14	TTMIN(I)	Monthly values of actual mean minimum temperature (°F)	12F6.0	User supplied
-----If KRCF = 0, omit Input No. 15-----				
15	RM(I)	Monthly values of actual mean precipitation amount (in.)	12F6.0	User supplied
-----If KGEN = 1, omit Input No. 16-----				
16	RAIN(I)	Actual precipitation data	User specified	User supplied



APPENDIX C

The WGEN Program

TABLE C1. LISTING OF FORTRAN PROGRAM FOR WGEN.

```

      DIMENSION TXM(366),TXS(366),TXM1(366),TXS1(366),TNM(366),TNS(366),
      1RMO(366),RSO(366),RM1(366),RS1(366),RC(366),RAIN(366),TMAX(366),
      2TMIN(366),RAD(366),ACOM(20),NI(12),SR(12),SSTX(12),SSTN(12),SSRAD(
      32),SRAIN(12),STMAX(12),STMIN(12),SRAD(12),NII(12),PWW(12),PWD(12),
      4ALPHA(12),BETA(12),TM(12),PW(12),TG(12),RM(12),RG(12),RCF(12)
      5NWET(12),XNW(12)
      DIMENSION TAMAX(12),TAMIN(12)
      DIMENSION TTMAX(12),TTMIN(12),TCFMAX(12),TCFMIN(12)
      DATA NI/31,59,90,120,151,181,212,243,273,304,334,365/
      DATA NII/31,60,91,121,152,182,213,244,274,305,335,366/
C*****
C* INPUT # 01 - TITLE *
C*   ACOM(I) - LOCATION IDENTIFICATION OR OTHER USER *
C*   COMMENTS. 80 CHARACTER MAXIMUM *
C*****
      READ(2,98)(ACOM(I),I=1,20)
98   FORMAT(20A4)
      WRITE(6,99)(ACOM(I),I=1,20)
99   FORMAT('1',20A4)
C*****
C* INPUT # 02 - NUMBER OF YEARS, GENERATION CODES, AND LATITUDE *
C*   NYRS - YEARS OF DATA TO BE GENERATED *
C*   KGEN - GENERATION OPTION CODE *
C*           IF KGEN = 1,RAIN, MAX TEMP, MIN TEMP, AND *
C*           SOLAR RADIATION WILL BE GENERATED *
C*           IF KGEN = 2 OBSERVED RAIN WILL BE USED AND *
C*           MAX TEMP, MIN TEMP, SOLAR RADIATION WILL *
C*           BE GENERATED *
C*   ALAT - STATION LATITUDE IN DEGREES *
C*   KTCF - TEMP. CORRECTION FACTOR OPTION CODE *
C*           IF KTCF = 0 NO TEMP CORRECTION WILL BE MADE *
C*           IF KTCF = 2 GENERATED MAX TEMP AND *
C*           MIN TEMP WILL BE CORRECTED BASED ON *
C*           OBSERVED MEAN MONTHLY MAX AND MIN TEMP *
C*           IF KTCF = 1 GENERATED MAX TEMP AND MIN TEMP *
C*           WILL BE CORRECTED BASED ON OBSERVED MEAN *
C*           MONTHLY TEMP *
C*   KRCF - RAIN CORRECTION FACTOR OPTION CODE *
C*           IF KRCF = 1 GENERATED RAIN WILL BE CORRECTED *
C*           BASED ON OBSERVED MEAN MONTHLY RAIN *
C*           IF KRCF = 0 NO RAIN CORRECTION WILL BE MADE *
C*****
      READ(2,100) NYRS,KGEN,ALAT,KTCF,KRCF
100  FORMAT(2I5,F5.0,2I5)
C***** CALCULATE MAXIMUM SOLAR RADIATION FOR EACH DAY
      XLAT = ALAT*6.2832/360.
      DO 6 I = 1,366
      XI = I
      SD = 0.4102*SIN(0.0172*(XI-80.25))
      CH = -TAN(XLAT)*TAN(SD)

```

TABLE C1. CONTINUED.

```

      IF(CH .GT. 1.0) H = 0.
      IF(CH .GT. 1.0) GO TO 5
      IF(CH .LT. -1.0)H=3.1416
      IF(CH .LT. -1.0) GO TO 5
      H = ARCCOS(CH)
5     DD = 1.0+0.0335*SIN(0.0172*(XI+88.2))
      RC(I)=889.2305*DD*((H*SIN(XLAT)*SIN(SD))+(COS(XLAT)*COS(SD)*SIN(H)
1))
      RC(I) = RC(I) * 0.8
6     CONTINUE
      DO 7 I = 1,12
      TTMAX(I)=0.
      TTMIN(I)=0.
      RM(I) = 0.
7     CONTINUE
      IF(KGEN .EQ. 2) GO TO 10
C*****
C*  NOTE--INPUTS #03,04,05,06 ARE RAINFALL PARAMETERS
C*  OMIT IF KGEN=2
C*****
C*  INPUT # 03 - PROBABILITY OF WET GIVEN WET
C*  PWW(I) - 12 MONTHLY VALUES OF P(W/W)
C*****
      READ(2,103) (PWW(I),I=1,12)
103  FORMAT(12F6.0)
C*****
C*  INPUT # 04 - PROBABILITY OF WET GIVEN DRY
C*  PWD(I) - 12 MONTHLY VALUES OF P(W/D)
C*****
      READ(2,103)(PWD(I),I=1,12)
C*****
C*  INPUT # 05 - GAMMA DISTRIBUTION SHAPE PARAMETER
C*  ALPHA(I) - 12 MONTHLY VALUES OF SHAPE PARAMETER
C*****
      READ(2,103)(ALPHA(I),I=1,12)
C*****
C*  INPUT # 06 - GAMMA DISTRIBUTION SCALE PARAMETER
C*  BETA(I) - 12 MONTHLY VALUES OF SCALE PARAMETER
C*****
      READ(2,103)(BETA(I),I=1,12)
101  FORMAT(9F8.0)
C*****
C*  INPUT # 07 - FOURIER COEFFICIENTS OF MAX TEMP ON DRY DAYS
C*  TXMD - MEAN OF TMAX - DRY
C*  ATX - AMPLITUDE OF TMAX - WET OR DRY
C*  CVTX - MEAN OF COEF. OF VAR. OF TMAX - WET OR DRY
C*  ACVTX - AMPLITUDE OF COEF.OF VAR. OF TMAX - WET OR DRY
C*****
10  READ(2,101) TXMD,ATX,CVTX,ACVTX

```

TABLE C1. CONTINUED.

```

C*****
C* INPUT # 08 - FOURIER COEFFICIENTS OF MAX TEMP ON WET DAYS *
C* TXMW - MEAN OF TMAX - WET *
C*****
      READ(2,101) TXMW
C*****
C* INPUT # 09 - FOURIER COEFFICIENTS OF MIN TEMP *
C* TN - MEAN OF TMIN - WET OR DRY *
C* ATN - AMPLITUDE OF TMIN - WET OR DRY *
C* CVTN - MEAN OF COEF. OF VAR. OF TMIN - WET OR DRY *
C* ACVTN - AMPLITUDE OF COEF. OF VAR. OF TMIN - WET OR DRY *
C*****
      READ(2,101) TN,ATN,CVTN,ACVTN
C*****
C* INPUT # 10 - FOURIER COEFFICIENTS OF RAD ON DRY DAYS *
C* RMD - MEAN OF RAD - DRY *
C* AR - AMPLITUDE OF RAD - WET OR DRY *
C*****
      READ(2,101) RMD,AR
      CVRD = 0.24
      ACVRD = -0.08
C*****
C* INPUT # 11 - FOURIER COEFFICIENTS OF RAD ON WET DAYS *
C* RMW - MEAN OF RAD - WET *
C*****
      READ(2,101) RMW
      CVRW = 0.48
      ACVRW = -0.13
      D1 = TXMD - TXMW
      D2 = RMD - RMW
      IF(KTCF .EQ. 0) GO TO 12
      IF(KTCF .EQ. 2) GO TO 8
C*****
C* INPUT # 12 - MONTHLY VALUES OF ACTUAL MEAN TEMP *
C* OMIT IF KTCF = 0 OR 2 *
C* TM(I) - 12 MONTHLY VALUES OF ACTUAL MEAN TEMP *
C*****
      READ(2,103) (TM(I),I=1,12)
      GO TO 12
C*****
C* INPUT # 13 - MONTHLY VALUES OF ACTUAL MEAN MAX TEMP *
C* OMIT IF KTCF = 0 OR 1 *
C* TTMAX(I) - 12 MONTHLY VALUES OF ACTUAL MEAN MAX TEMP *
C*****
      READ(2,103) (TTMAX(I),I=1,12)
C*****
C* INPUT # 14 - MONTHLY VALUES OF ACTUAL MEAN MIN TEMP *
C* OMIT IF KTCF = 0 OR 1 *
C* TTMIN(I) - 12 MONTHLY VALUES OF ACTUAL MEAN MIN TEMP *
C*****

```

TABLE C1. CONTINUED.

```

      READ(2,103) (TTMIN(I),I=1,12)
12    IF(KRCF .EQ. 0) GO TO 13
C*****
C*   INPUT # 15 - MONTHLY VALUES OF ACTUAL MEAN RAINFALL      *
C*           OMIT IF KRCF = 0                                   *
C*   RM(I) = 12 MONTHLY VALUES OF ACTUAL MEAN RAINFALL      *
C*****
      READ(2,103)(RM(I),I=1,12)
13    WRITE(6,700)
700    FORMAT(////,10X,'GENERATION PARAMETERS',//,15X,'PRECIPITATION')
      WRITE(6,701)(PWW(I),I=1,12)
701    FORMAT(20X,'P(W/W) ',12F7.3)
      WRITE(6,702)(PWD(I),I=1,12)
702    FORMAT(20X,'P(W/D) ',12F7.3)
      WRITE(6,703)(ALPHA(I),I=1,12)
703    FORMAT(20X,'ALPHA ',12F7.3)
      WRITE(6,704)(BETA(I),I=1,12)
704    FORMAT(20X,'BETA ',12F7.3)
      WRITE(6,705)TXMD,ATX,CVTX,ACVTX,TXMW
705    FORMAT(15X,'MAXIMUM TEMPERATURE',/,20X,'TXMD = ',F8.3,/,20X,
* 'ATX = ',F8.3,/,20X,'CVTX = ',F8.3,/,20X,'ACVTX = ',F8.3,/,20X,
* 'TXMW = ',F8.3,/)
      WRITE(6,706)TN,ATN,CVTN,ACVTN
706    FORMAT(15X,'MINIMUM TEMPERATURE',/,20X,'TN = ',F8.3,/,20X,
* 'ATW = ',F8.3,/,20X,'CVTN = ',F8.3,/,20X,'ACVTN = ',F8.3,/)
      WRITE(6,707)RMD,AR,RMW
707    FORMAT(15X,'SOLAR RADIATION',/,20X,'RMD = ',F8.3,/,20X,
* 'AR = ',F8.3,/,20X,'RMW = ',F8.3,/)
      DO 11 J = 1,366
      XJ = J
      DT = COS(.0172*(XJ-200.))
      DR = COS(.0172*(XJ-172.))
      TXM(J) = TXMD+ATX*DT
      XCR1=CVTX+ACVTX*DT
      IF(XCR1 .LT. 0.0) XCR1=0.06
      TXS(J)=TXM(J)*XCR1
      TXM1(J) = TXM(J) - D1
      TXS1(J)=TXM1(J)*XCR1
      TNM(J) = TN + ATN*DT
      XCR2=CVTN+ACVTN*DT
      IF(XCR2 .LT. 0.0) XCR2=0.06
      TNS(J)=TNM(J)*XCR2
      RMO(J) = RMD+AR * DR
      XCR3=CVRD+ACVRD*DR
      IF(XCR3 .LT. 0.0) XCR3=0.06
      RSO(J)=RMO(J)*XCR3
      RM1(J) = RMO(J) - D2
      XCR4=CVRW+ACVRW*DR
      IF(XCR4 .LT. 0.0) XCR4=0.06
      RS1(J)=RM1(J)*XCR4

```

TABLE C1. CONTINUED.

```

11  CONTINUE
    DO 22 IM=1,12
      XNW(IM) = 0.
      SR(IM) = 0.
      SSTX(IM) = 0.
      SSTN(IM) = 0.
      SSRAD(IM) = 0.
      TCFMAX(IM) = 0.0
      TCFMIN(IM) = 0.0
      RCF(IM) = 1.0
      PW(IM) = PWD(IM)/(1.-PWW(IM)+PWD(IM))
      S1 = 0.
      S2 = 0.
      S3 = 0.
      NL = NI(IM)
      IF(IM.EQ.1) GO TO 14
      NF = NI(IM-1) + 1
      GO TO 15
14  NF = 1
15  CONTINUE
      ZN = NL - NF + 1
      DO 16 J = NF,NL
        S1 = S1 + TXM(J)/ZN
        S2 = S2 + TXM1(J)/ZN
        S3 = S3 + TNM(J)/ZN
16  CONTINUE
C*****CALCULATE MONTHLY RAINFALL CORRECTION FACTOR
      RG(IM) = ALPHA(IM)*BETA(IM)*ZN*PW(IM)
      IF(KRCF.EQ.0) GO TO 17
      RCF(IM) = RM(IM)/RG(IM)
17  IF(KTCF.EQ.0) GO TO 22
C*****CALCULATE MONTHLY TEMP CORRECTION FACTOR
      IF(KTCF.EQ.2) GO TO 18
      TMD = (S1 + S3) / 2.
      TMW = (S2 + S3) / 2.
      TG(IM) = TMW*PW(IM)+TMD*(1-PW(IM))
      TCFMAX(IM) = TM(IM) - TG(IM)
      TCFMIN(IM) = TCFMAX(IM)
      GO TO 22
18  TAMAX(IM)=S2*PW(IM) + S1*(1.-PW(IM))
      TAMIN(IM)=S3
      IF(KTCF.EQ.0.) GO TO 22
      TCFMAX(IM)=TTMAX(IM)-TAMAX(IM)
      TCFMIN(IM)=TTMIN(IM)-TAMIN(IM)
22  CONTINUE
      IF(KRCF.EQ.0) GO TO 52
      WRITE(6,712)(RM(I),I=1,12)
712  FORMAT(10X,'ACT MEAN RAIN',12F7.2)
      WRITE(6,713) (RG(I),I=1,12)
713  FORMAT(10X,'EST MEAN RAIN',12F7.2)

```


TABLE C1. CONTINUED.

```

WRITE(6,714)(RCF(I),I=1,12)
714  FORMAT(10X,'RAIN CF      ',12F7.3)
52   IF (KTCF .EQ. 0) GO TO 19
      IF(KTCF .EQ. 2) GO TO 51
      WRITE(6,708) (TM(I),I=1,12)
708  FORMAT(10X,'ACT MEAN TEMP',12F7.1)
      WRITE(6,711)(TG(I),I=1,12)
711  FORMAT(10X,'EST MEAN TEMP',12F7.1)
      GO TO 50
51   WRITE(6,722) (TTMAX(I),I=1,12)
722  FORMAT(10X,'ACT MEAN TMAX',12F7.1)
      WRITE(6,723) (TTMIN(I),I=1,12)
723  FORMAT(10X,'ACT MEAN TMIN',12F7.1)
      WRITE(6,720) (TAMAX(I),I=1,12)
720  FORMAT(10X,'EST MEAN TMAX',12F7.1)
      WRITE(6,721) (TAMIN(I),I=1,12)
721  FORMAT(10X,'EST MEAN TMIN',12F7.1)
50   WRITE(6,709) (TCFMAX(I),I=1,12)
709  FORMAT(10X,'CF. MEAN TMAX',12F7.1)
      WRITE(6,724) (TCFMIN(I),I=1,12)
724  FORMAT(10X,'CF. MEAN TMIN',12F7.1)
19   XYR = NYRS
      SYTX = 0.
      SYTN = 0.
      SYRAD = 0.
      SYR = 0.
      SYNW = 0.
      DO 40 I = 1,NYRS
      IYR = I
      IF(KGEN .EQ. 1) GO TO 20
      KK = 0
      IU = 1
C*****
C*  INPUT # 16 - MEASURED RAINFALL FOR NYRS
C*                OMIT IF KGEN = 1
C*  RAIN(I) - ACTUAL RAINFALL DATA - ONE VALUE PER OAY
C*                FOR NYRS
C*****
21   READ(2,102) IYR,M0,IOAY,RAIN(IU)
102  FORMAT(4X,3I2,20X,F10.0)
      IF(KK .EQ. 1) GO TO 24
20   IOAYS = 365
      IFLG= M00(IYR,4)
      IF(IFLG .EQ. 0) IOAYS = 366
      KK = 1
      IF(KGEN .EQ. 1) GO TO 28
24   IU = IU + 1
      IF(IU .LE. IOAYS) GO TO 21
28   CONTINUE

```

TABLE C1. CDNTINUED.

```

      CALL WGEN(PWW,PWD,ALPHA,BETA,TXM,TXS,TXM1,TXS1,TNM,TNS,RMO,RSO,
*RM1,RS1,RAIN,TMAX,TMIN,RAD,KGEN,RC,IDAYS,NI,NII,
*TCFMAX,TCFMIN,RCF)
      DO 23 IM = 1,12
        SRAIN(IM) = 0.
        STMAX(IM) = 0.
        STMIN(IM) = 0.
        SRAD(IM) = 0.
        NWET(IM) = 0
23      CDNTINUE
        IM = 1
        YTMAX = 0.
        YTMIN = 0.
        YRAD = 0.
        RYR = 0.
        NYWET = 0
        IDA = 0
        DO 30 J=1,IDAYS
          IDA = IDA + 1
          IF(IDAYS.EQ.366) GD TD 27
          IF(J.GT.NI(IM)) GO TO 251
          GD TD 29
251        IM = IM + 1
          IDA = 1
          GO TO 29
27        IF(J.GT.NII(IM)) GD TD 251
29        CONTINUE
C*****THE FOLLOWING STATEMENT WRITES DAILY GENERATED WEATHER DN AN
C*****EXTERNAL FILE (UNIT 8).
          WRITE(8,200)IM,IDA,IYR,J,RAIN(J),TMAX(J),TMIN(J),RAD(J)
800        CDNTINUE
C*****THE FOLLOWING STATEMENT PRINTS DAILY GENERATED WEATHER
          WRITE(6,200)IM,IDA,IYR,J,RAIN(J),TMAX(J),TMIN(J),RAD(J)
200        FORMAT(2X,4I5,F7.2,3F7.0)
25        CDNTINUE
          IF(RAIN(J).LT.0.005) GD TD 26
          NWET(IM) = NWET(IM) + 1
          NYWET = NYWET + 1
26        CONTINUE
          SRAIN(IM) = SRAIN(IM) + RAIN(J)
          STMAX(IM) = STMAX(IM) + TMAX(J)
          STMIN(IM) = STMIN(IM) + TMIN(J)
          SRAD(IM) = SRAD(IM) + RAD(J)
          RYR = RYR + RAIN(J)
30        CONTINUE
          XNM1 = 0.
          DO 35 IM = 1,12
            XXN = NI(IM)
            XNI = XXN - XNM1
            XNM1 = XXN

```

TABLE C1. CONTINUED.

```

ANW = NWET(IM)
XNW(IM) = XNW(IM) + ANW/XYR
SR(IM) = SR(IM) + SRAIN(IM) / XYR
STMAX(IM) = STMAX(IM) / XNI
SSTX(IM) = SSTX(IM) + STMAX(IM) / XYR
STMIN(IM) = STMIN(IM) / XNI
SSTN(IM) = SSTN(IM) + STMIN(IM) / XYR
SRAO(IM) = SRAO(IM) / XNI
SSRAO(IM) = SSRAO(IM) + SRAO(IM) / XYR
YTMAX = YTMAX + STMAX(IM) / 12.
YTMIN = YTMIN + STMIN(IM) / 12.
YRAO = YRAO + SRAD(IM) / 12.
35  CONTINUE
    SYTX = SYTX + YTMAX/XYR
    SYTN = SYTN + YTMIN/XYR
    SYRAD = SYRAD + YRAO / XYR
    SYR = SYR + RYR / XYR
    XYNW = NYWET
    SYNW = SYNW + XYNW / XYR
    WRITE(6,201) IYR
201  FORMAT(//,5X,'SUMMARY FOR YEAR',I5,/,2X,'MONTH
* 2      3      4      5      6      7      8      9      10
*      11      12      YR',/)
    WRITE(6,207)(NWET(IM),IM=1,12),NYWET
207  FORMAT(2X,'WET DAYS      ',13I8)
    WRITE(6,202)(SRAIN(IM),IM=1,12),RYR
202  FORMAT(2X,'RAINFALL      ',13F8.2)
    WRITE(6,203)(STMAX(IM),IM=1,12),YTMAX
203  FORMAT(2X,'AVE MAX TEMP',13F8.2)
    WRITE(6,204)(STMIN(IM),IM=1,12),YTMIN
204  FORMAT(2X,'AVE MIN TEMP',13F8.2)
    WRITE(6,205)(SRAO(IM),IM=1,12),YRAO
205  FORMAT(2X,'AVE RAO      ',13F8.2)
40  CONTINUE
    WRITE(6,206)NYRS
206  FORMAT(///,5X,'SUMMARY FOR',I5,'YEARS')
    WRITE(6,208)(XNW(IM),IM=1,12),SYNW
208  FORMAT(2X,'WET DAYS      ',13F8.2)
    WRITE(6,202)(SR(IM),IM=1,12),SYR
    WRITE(6,203)(SSTX(IM),IM=1,12),SYTX
    WRITE(6,204)(SSTN(IM),IM=1,12),SYTN
    WRITE(6,205)(SSRAO(IM),IM=1,12),SYRAD
999  STOP
    END
C*****THE FOLLOWING SUBROUTINE GENERATES DAILY WEATHER DATA FOR
C*****ONE YEAR.
    SUBROUTINE WGEN(PWW,PWO,ALPHA,BETA,TXM,TXS,TXM1,TXS1,TNM,TNS,RMO,
1RSO,RM1,RS1,RAIN,TMAX,TMIN,RAD,KGEN,RC,IOAYS,NI,NII,
2TCFMAX,TCFMIN,RCF)

```

TABLE C1. CONTINUED.

```

DIMENSION TXM(366),TXS(366),TXM1(366),
1 TXS1(366),TNM(366),TNS(366),RMO(366),RSO(366),RM1(366),RS1(366),
2 RAIN(366),TMAX(366),TMIN(366),RAD(366),RC(366),A(3,3),B(3,3),
3 XIM1(3),E(3),R(3),X(3),RR(3),PWW(12),PWD(12),ALPHA(12),BETA(12),
4 NI(12),NII(12),TCF(12),RCF(12)
DIMENSION TCFMAX(12),TCFMIN(12)
DATA A/O.567,O.253,-O.006,O.086,O.504,-O.039,-O.002,-O.050,O.244/
DATA B/O.781,O.328,O.238,O.0,O.637,-O.341,O.0,O.0,O.873/
DATA XIM1/O.,O.,O./
DATA IX/9398039/
DATA IP/O/
IM = 1
DO 50 IDAY=1,IDAYS
IF(IDAYS .EQ. 366) GO TO 2
IF(IDAY .GT. NI(IM)) IM = IM + 1
GD TO 4
2 IF(IDAY .GT. NII(IM)) IM = IM + 1
4 CDNTINUE
IF(KGEN .EQ. 2) GO TO 15
C*****DETERMINE WET DR DRY DAY USING MARKOV CHAIN MODEL
CALL RANDN(RN)
IF(IP-O) 7,7,10
7 IF(RN - PWD(IM ))11,11,8
8 IP = O
RAIN(IDAY) = O.
GO TO 18
10 IF(RN-PWW(IM ))11,11,8
11 IP = 1
C*****DETERMINE RAINFALL AMOUNT FOR WET DAYS USING GAMMA DISTRIBUTION
AA = 1./ALPHA(IM)
AB = 1./(1.-ALPHA(IM))
TR1 = EXP(-18.42/AA)
TR2 = EXP(-18.42/AB)
SUM = O.
SUM2 = O.
12 CALL RANDN(RN1)
CALL RANDN(RN2)
IF(RN1-TR1) 61,61,62
61 S1 = O.
GD TO 63
62 S1 = RN1**AA
63 IF(RN2-TR2) 64,64,65
64 S2 = O.
GD TO 66
65 S2 = RN2**AB
66 S12 = S1 + S2
IF(S12-1.) 13,13,12
13 Z = S1/S12
CALL RANDN(RN3)
RAIN(IDAY) = -Z*ALDG(RN3)*BETA(IM)*RCF(IM)

```

TABLE C1. CONTINUED.

```

C*****RAIN(IDAY) IS GENERATED RAINFALL FOR IDAY
15   IF(RAIN(IDAY)) 16,16,17
16   IP = 0
      GO TO 18
17   IP = 1
18   IF(IP-1) 25,26,26
C*****GENERATE TMAX, TMIN, AND RAO FOR IDAY
25   RM=RMO(IDAY)
      RS = RSO(IDAY)
      TXXM = TXM(IDAY)
      TXXS = TXS(IDAY)
      GO TO 27
26   RM = RM1(IDAY)
      RS = RS1(IDAY)
      TXXM = TXM1(IDAY)
      TXXS = TXS1(IDAY)
27   CONTINUE
      DO 30 K = 1,3
131  AA = 0.
      CALL RANDN(RN1)
      CALL RANON(RN2)
      V = SQRT(-2.*ALOG(RN1))*COS(6.283185*RN2)
      IF(ABS(V) .GT. 2.5) GO TO 131
      E(K) = V
30   CONTINUE
      DO 31 I = 1,3
      R(I) = 0.
      RR(I) = 0.
31   CONTINUE
      DO 32 I = 1,3
      DO 32 J = 1,3
      R(I) = R(I)+B(I,J)*E(J)
      RR(I) = RR(I) + A(I,J)*XIM1(J)
32   CONTINUE
      DO 37 K = 1,3
      X(K) = R(K) + RR(K)
      XIM1(K) = X(K)
37   CONTINUE
      TMAX(IDAY) = X(1) * TXXS + TXXM
      TMIN(IDAY) = X(2)*TNS(IDAY)+TNM(IDAY)
      IF(TMIN(IDAY) .GT. TMAX(IDAY)) GO TO 38
      GO TO 39
38   TMM = TMAX(IDAY)
      TMAX(IDAY) = TMIN(IDAY)
      TMIN(IDAY) = TMM
39   CONTINUE
      TMAX(IDAY)=TMAX(IDAY)+TCFMAX(IM)
      TMIN(IDAY)=TMIN(IDAY)+TCFMIN(IM)
C*****TMAX(IDAY) IS GENERATED TMAX FOR IDAY
C*****TMIN(IDAY) IS GENERATED TMIN FOR IDAY

```


TABLE C1. CONTINUED.

```

      RAD(IDAY) = X(3)*RS+RM
      RMIN = 0.2*RC(IDAY)
      IF(RAD(IDAY) .LT. RMIN) RAD(IDAY) = RMIN
      IF(RAD(IDAY) .GT. RC(IDAY)) RAD(IDAY) = RC(IDAY)
C*****RAD(IDAY) IS GENERATED RAD FOR IDAY
50    CONTINUE
      RETURN
      END
C*****THE FOLLOWING SUBROUTINE GENERATES A UNIFORM RANDOM NUMBER ON
C*****THE INTERVAL 0 - 1
      SUBROUTINE RANDN(YFL)
      DIMENSION K(4)
      DATA K/2510,7692,2456,3765/
      K(4) = 3*K(4)+K(2)
      K(3) = 3*K(3)+K(1)
      K(2)=3*K(2)
      K(1) = 3*K(1)
      I=K(1)/1000
      K(1)=K(1)-I*1000
      K(2)=K(2) + I
      I = K(2)/100
      K(2)=K(2)-100*I
      K(3) = K(3)+I
      I = K(3)/1000
      K(3)=K(3)-I*1000
      K(4)=K(4)+I
      I = K(4)/100
      K(4)=K(4)-100*I
      YFL=(( (FLOAT(K(1))* .001+FLOAT(K(2)))* .01+FLOAT(K(3)))* .001+FLOAT
      *(K(4)))* .01
      RETURN
      END

```

APPENDIX D
The WGEN PAR Program

TABLE 01. LISTING OF FORTRAN PROGRAM FOR WGEN PAR.

```

C*****
C*
C*          DEE ALLEN WRIGHT
C*          COMPUTER PRDGRAMMER
C*          FEBRUARY 25, 1983
C*
C*****
      DIMENSION TMAX(20,365),TMIN(20,365),RAIN(20,365),RAD(20,365)
      DIMENSION AA(20)
      DIMENSION RC(365)
      DIMENSION XDATA(30),YOATA(4,12)
      DD1I=1,30
      XDATA(I)=0.0
1      CDNTINUE
      DD2I=1,4
      DD2J=1,12
      YDATA(I,J)=0.0
2      CDNTINUE
C*****
C*
C*          INPUT #1  TITLE OF DATA SET (20A4)
C*
C*****
      READ(5,100)(AA(I),I=1,20)
100      FDMAT(20A4)
      WRITE(6,101) (AA(I),I=1,20)
101      FDMAT('1',//,30X,'DATA IS -----',20A4,/)
C*****
C*
C*          INPUT #2  NUMBER OF YEARS AND LATITUDE
C*
C*****
      READ(5,102) NYRS,ALAT
102      FDMAT(I10,F10.0)
C*****CALCULATE MAXIMUM SOLAR RADIATION FOR EACH DAY.
      XYRS=NYRS
      XLAT=ALAT*6.2832/360.
      DD 6 I = 1,365
      XI = I
      SD = 0.4102*SIN(0.0172*(XI-80.25))
      CH = -TAN(XLAT)*TAN(SD)
      IF (CH .GT. 1.0) H = 0.
      IF (CH .GT. 1.0) GO TO 5
      IF(CH .LT. -1.0) H = 3.1416
      IF(CH .LT. -1.0) GO TO 5
      H = ARCCOS(CH)
5      DO=1.0+0.0335*SIN(0.0172 *(XI+88.2))
      RC(I)=889.2305*DD*((H*SIN(XLAT)*SIN(SD))+(CDS(XLAT)*CDS(SD)*SIN(H)
*) )
      RC(I)=RC(I)*0.80

```

TABLE D1. CONTINUED.

```

6      CONTINUE
      DO 7 I = 1,NYRS
      DO 7 J = 1,365
C*****
C*
C*      INPUT #3  MO, DAY, YEAR, MAX TEMP, MIN TEMP, RAINFALL, RADIATION
C*
C*****
8      READ(5,103) IMO,IDA,IYR,V1,V2,V3,V4
      IF(IMO .EQ. 2 .AND. IDA .EQ. 29) GO TO 8
      TMAX(I,J) = V1
      TMIN(I,J) = V2
      RAIN(I,J) = V3
      RAD(I,J) = V4
      IF(RAD(I,J) .GT. RC(J)) RAD(I,J)=RC(J)
7      CONTINUE
103     FORMAT(3I2,3F6.0,6X,F6.0)
      WRITE(6,104)
104     FORMAT('1',///,5X,'MAXIMUM TEMPERATURE',/)
C*****CALCULATE TMAX PARAMETERS
      CALL MSD(NYRS,TMAX,RAIN,1,XDATA)
      WRITE(6,105)
105     FORMAT('1',///,5X,'MINIMUM TEMPERATURE',/)
C*****CALCULATE TMIN PARAMETERS
      CALL MSD(NYRS,TMIN,RAIN,2,XDATA)
      WRITE(6,106)
106     FORMAT('1',///,5X,'SOLAR RADIATION ',/)
C*****CALCULATE RAD PARAMETERS
      CALL MSD(NYRS,RAD,RAIN,3,XDATA)
      WRITE(6,107)
107     FORMAT('1',///,5X,'PRECIPITATION')
C*****CALCULATE RAINFALL PARAMETERS
      CALL PPRAIN(RAIN,NYRS,YDATA)
C--PHASE ANGLE SHIFTED BY 180 DEGREES
C--AND SIGNS CHANGED ON AMPLITUDES
      XDATA(02)=XDATA(02)*(-1.0)
      XDATA(04)=XDATA(04)*(-1.0)
      XDATA(10)=XDATA(10)*(-1.0)
      XDATA(12)=XDATA(12)*(-1.0)
      XDATA(14)=XDATA(14)*(-1.0)
      WRITE(6,101) (AA(I),I=1,20)
C*****WRITE GENERATION PARAMETERS FOR INPUT TO WGEN PROGRAM
      WRITE(6,707)
707     FORMAT(///,20X,'INPUT CARDS FOR THE WEATHER GENERATOR ARE AS FOLLO
*WS -----',///)
      WRITE(6,403)
403     FORMAT(///)
      WRITE(6,513) (YDATA(1,J),J=1,12)
      WRITE(6,514) (YDATA(2,J),J=1,12)
      WRITE(6,515) (YDATA(3,J),J=1,12)

```

TABLE D1. CONTINUED.

```

WRITE(6,516) (YDATA(4,J),J=1,12)
513 FORMAT(5X,'INPUT # 3 ---- P(W/W) ---- ',12F6.3)
514 FORMAT(5X,'INPUT # 4 ---- P(W/D) ---- ',12F6.3)
515 FORMAT(5X,'INPUT # 5 ---- ALPHA ---- ',12F6.3)
516 FORMAT(5X,'INPUT # 6 ---- BETA ---- ',12F6.3)
WRITE(6,400)
400 FORMAT(////)
WRITE(6,701)
WRITE(6,501) XDATA(01)
WRITE(6,502) XDATA(02)
WRITE(6,503) XDATA(03)
WRITE(6,504) XDATA(04)
701 FORMAT(5X,'INPUT # 7 ----',/)
501 FORMAT(15X,' 1 TXMD ---- ',F10.3)
502 FORMAT(15X,' 2 ATX ---- ',F10.3)
503 FORMAT(15X,' 3 CVTX ---- ',F10.3)
504 FORMAT(15X,' 4 ACVTX ---- ',F10.3)
WRITE(6,702)
702 FORMAT(//,5X,'INPUT # 8 ----',/)
WRITE(6,505) XDATA(05)
505 FORMAT(15X,' 5 TXMW ---- ',F10.3)
WRITE(6,703)
703 FORMAT(//,5X,'INPUT # 9 ----',/)
WRITE(6,506) XDATA(09)
WRITE(6,507) XDATA(10)
WRITE(6,508) XDATA(11)
WRITE(6,509) XDATA(12)
506 FORMAT(15X,' 6 TN ---- ',F10.3)
507 FORMAT(15X,' 7 ATN ---- ',F10.3)
508 FORMAT(15X,' 8 CVTN ---- ',F10.3)
509 FORMAT(15X,' 9 ACVTN ---- ',F10.3)
WRITE(6,704)
704 FORMAT(//,5X,'INPUT # 10 ----',/)
WRITE(6,510) XDATA(13)
WRITE(6,511) XDATA(14)
510 FORMAT(15X,'10 RMD ---- ',F10.3)
511 FORMAT(15X,'11 AR ---- ',F10.3)
WRITE(6,705)
705 FORMAT(//,5X,'INPUT # 11 ----',/)
WRITE(6,512) XDATA(17)
512 FORMAT(15X,'12 RMW ---- ',F10.3)
WRITE(6,600)
600 FORMAT('1')
STOP
END
C*****THE FOLLOWING SUBROUTINE CALCULATES A ONE HARMONIC FOURIER SERIES
SUBROUTINE FOUR(XM,SD,CV,XDATA)
DIMENSION XM(13),SD(13)
DIMENSION CV(13)
DIMENSION XDATA(30)

```


TABLE D1. CONTINUED.

```

DATA JCT /O/
S = 0.
S1 = 0.
S2 = 0.
WRITE(6,200)
200  FORMAT(/,33X,'      PERIOD    MEAN    STD DEV    CV')
DO 10 I = 1,13
WRITE(6,201)I,XM(I),SD(I),CV(I)
201  FORMAT(30X,I10,3F10.2)
S = S + XM(I)
S1 = S1 + SD(I)
S2 = S2 + CV(I)
10  CONTINUE
XBAR=S/13.
XBAR1=S1/13.
XBAR2=S2/13.
SUMA = 0.
SUMB = 0.
SUMA1 = 0.
SUMB1 = 0.
SUMA2=0.
SUMB2 = 0.
DO 15 K = 1,13
XK = K
SUMA=SUMA+(XM(K)-XBAR)*COS(6.2832*XK/13.)
SUMA1=SUMA1+(SD(K)-XBAR1)*COS(6.2832*XK/13.)
SUMA2=SUMA2+(CV(K)-XBAR2)*COS(6.2832*XK/13.)
SUMB=SUMB+(XM(K)-XBAR)*SIN(6.2832*XK/13.)
SUMB1=SUMB1+(SD(K)-XBAR1)*SIN(6.2832*XK/13.)
SUMB2=SUMB2+(CV(K)-XBAR2)*SIN(6.2832*XK/13.)
15  CONTINUE
A = SUMA*(2./13.)
A1= SUMA1*(2./13.)
A2 = SUMA2*(2./13.)
B = SUMB*(2./13.)
B1 = SUMB1*(2./13.)
B2 = SUMB2*(2./13.)
T = ATAN(-B/A)
T1= ATAN(-B1/A1)
T2=ATAN(-B2/A2)
C = A/COS(T)
C1 = A1/COS(T1)
C2 = A2/COS(T2)
WRITE(6,100)
100  FORMAT(/,15X,'FOURIER COEFFICIENTS--MEAN')
WRITE(6,101) XBAR,C,T
101  FORMAT(15X,'MEAN =',F10.4,5X,'AMPLITUDE =',F10.4,5X,'PHASE =',
*F10.4)
JCT=JCT+1
XDATA(JCT)=XBAR

```

TABLE D1. CONTINUED.

```

      JCT=JCT+1
      XDATA(JCT)=C
      WRITE(6,102)
102  FDRMAT(/,15X,'FOURIER COEFFICIENTS--STD. DEV.')
      WRITE(6,101)XBAR1,C1,T1
      WRITE(6,103)
103  FORMAT(/,15X,'FOURIER COEFFICIENTS--CV')
      WRITE(6,101) XBAR2,C2,T2
      JCT=JCT+1
      XDATA(JCT)=XBAR2
      JCT=JCT+1
      XDATA(JCT)=C2
      RETURN
      END
C*****THE FOLLDWING SUBROUTINE CALCULATES THE STATISTICS OF TMAX, TMIN, AND RAD
C*****BY 28-OAY PERIDO OF THE YEAR AND FITS A FOURIER SERIES TO THE RESULTS.
      SUBROUTINE MSD(NYRS,W,RAIN,ID,XDATA)
      DIMENSION W(20,365),RAIN(20,365),XM(13),XM1(13),SD(13),SD1(13)
      DIMENSION CX(13),CX1(13)
      DIMENSION XDATA(30)
      DO 20 I = 1,13
      NF=I*28
      NI=NF-27
      XN = 0.
      XN1 = 0.
      SUM = 0.
      SUM1 = 0.
      SS = 0.
      SS1 = 0.
      DO 15 JD=NI,NF
      DO 15 JY = 1,NYRS
      IF(ID .EQ. 2) GO TO 11
      IF(RAIN(JY,JD))11,11,12
11  CONTINUE
      XN = XN + 1.
      SUM = SUM+W(JY,JD)
      SS = SS + (W(JY,JD)*W(JY,JD))
      GO TO 15
12  CONTINUE
      XN1 = XN1 + 1.
      SUM1 = SUM1 + W(JY,JD)
      SS1=SS1+(W(JY,JD)*W(JY,JD))
15  CONTINUE
      IF(XN .LE. 2.) XM(I) = 0.
      IF(XN .LE. 2.) SD(I) = 0.
      IF(XN .LE. 2.) CX(I) = 0.
      IF(XN .LE. 2.) GO TO 400
      XM(I) = SUM / XN
      SD(I) = SQRT((SS-SUM*SUM/XN)/(XN-1.))
      IF(XM(I) .LT. 0.001) XM(I) = 0.001

```

TABLE D1. CDNTINUED.

```

      CX(I) = SD(I) / XM(I)
400  CONTINUE
      IF(ID .EQ. 2) GO TO 20
      IF(XN1 .LE. 2.) XM1(I)=0.
      IF(XN1 .LE. 2.) SD1(I) = 0.
      IF(XN1 .LE. 2.) CX1(I) = 0.
      IF(XN1 .LE. 2.) GO TO 500
      XM1(I) = SUM1 / XN1
      SD1(I)=SQRT((SS1-SUM1*SUM1/XN1)/(XN1-1.))
      IF(XM1(I) .LT. 0.001) XM1(I) = 0.001
      CX1(I)=SD1(I)/XM1(I)
500  CDNTINUE
20   CDNTINUE
      IF(ID .EQ. 2) GO TO 25
      WRITE(6,100)
100  FDMAT(10X,'DRY DAYS')
      CALL FDUR(XM,SD,CX,XDATA)
      WRITE(6,101)
101  FDMAT(/,10X,'WET DAYS')
      CALL FDUR(XM1,SD1,CX1,XDATA)
      GO TO 30
25   WRITE(6,102)
102  FDMAT(10X,'WET AND DRY DAYS')
      CALL FDUR(XM,SD,CX,XDATA)
30   CDNTINUE
      RETURN
      END
*****THIS SUBRDUTINE CALCULATES THE RAINFALL GENERATIDN PARAMETERS
*****USING THE MARKOV CHAIN-GAMMA MDEL
      SUBRDUTINE PPRAIN(XRAIN,NYR,YDATA)
      DIMENSION XRAIN(20,365)
      DIMENSION NWD(12),NDD(12),NDW(12),NWW(12)
      DIMENSION SUM(12),SUM2(12),SUM3(12)
      DIMENSION SL(12),PWW(12),PWD(12),RBAR(12)
      DIMENSION ALPHA(12),BETA(12)
      DIMENSION NW(12),IC(12),SUML(12)
      DIMENSION RLBAR(12),AL2(12),BE2(12),DATE(12)
      DIMENSION PPPW(12),ND(12)
      DIMENSION YDATA(4,12)
      CHARACTER *36 A(2)
      DATA DATE /'JAN.','FEB.','MAR.','APR.','MAY ','JUNE',
*              'JULY','AUG.','SEP.','DCT.','NDV.','DEC.'/
      DATA A(1) /'
      DATA A(2) /'NDT ENDUGH DATA TD DEFINE PARAMETERS'/
      DD 10 I =1,12
      ND(I) = 0
      PPPW(I) = 0.
      NWD(I) = 0
      NWW(I) = 0
      NDD(I) = 0

```

TABLE D1. CONTINUED.

```

NDW(I) = 0
NW(I) = 0
SL(I) = 0.
SUML(I) = 0.
SUM(I) = 0.
SUM2(I) = 0.
PWW(I) = 0.
PWO(I) = 0.
ALPHA(I) = 0.
BETA(I) = 0.
10 SUM3(I) = 0.
   XYR=NYR
   RIM1 = 0.
   OO 20 J = 1,NYR
   OO 30 K = 1,365
   IF(K .GE. 001 .AND. K .LE. 031) MO = 1
   IF(K .GE. 032 .AND. K .LE. 059) MO = 2
   IF(K .GE. 060 .AND. K .LE. 090) MO = 3
   IF(K .GE. 091 .AND. K .LE. 120) MO = 4
   IF(K .GE. 121 .AND. K .LE. 151) MO = 5
   IF(K .GE. 152 .AND. K .LE. 181) MO = 6
   IF(K .GE. 182 .AND. K .LE. 212) MO = 7
   IF(K .GE. 213 .AND. K .LE. 243) MO = 8
   IF(K .GE. 244 .AND. K .LE. 273) MO = 9
   IF(K .GE. 274 .AND. K .LE. 304) MO = 10
   IF(K .GE. 305 .AND. K .LE. 334) MO = 11
   IF(K .GE. 335 .AND. K .LE. 365) MO = 12
   RAIN=XRAIN(J,K)
   IF(RAIN .GT. 0.00) NW(MO)=NW(MO)+1
   ND(MO)=ND(MO)+1
   IF(RAIN) 5,5,3
   3 IF(RIM1)2,2,4
   2 NWO(MO)=NWO(MO)+1
   GO TO 6
   4 NWW(MO)=NWW(MO)+1
   6 CONTINUE
   SUML(MO)=SUML(MO)+ALOG(RAIN)
   SUM(MO)=SUM(MO)+RAIN
   SUM2(MO)=SUM2(MO) + RAIN * RAIN
   SUM3(MO)=SUM3(MO)+RAIN*RAIN*RAIN
   SL(MO) = SL(MO)+ALOG(RAIN)
   GO TO 9
   5 IF(RIM1) 7,7,8
   7 NOD(MO)=NOD(MO)+1
   GO TO 9
   8 NOW(MO)=NDW(MO)+1
   9 RIM1 = RAIN
   30 CONTINUE
   20 CONTINUE
   OO 120 I = 1,12

```

TABLE D1. CONTINUED.

```

      XXND=ND(I)
      YYNW=NW(I)
      PPPW(I) = YYNW/XXND
      III=1
      IF(NW(I) .LT. 3) III=2
      IC(I) = III
      IF(NW(I) .LT. 3) GO TO 120
      XNWW=NWW(I)
      XNWD=NWD(I)
      XXNW=NWW(I)+NWD(I)
      XND=NDD(I)+NWD(I)
      XNW=NW(I)
      PWW(I)=XNWW/XXNW
      PWD(I)=XNWD/XND
      RBAR(I)=SUM(I)/XNW
      RLBAR(I)=SUML(I)/XNW
      Y=ALOG(RBAR(I))-RLBAR(I)
      ANUM=8.898919+9.05995*Y+0.9775373*Y*Y
      ADOM=Y*(17.79728+11.968477*Y+Y*Y)
      ALPHA2=ANUM/ADOM
      IF(ALPHA2 .GE. 1.0) ALPHA2=0.998
      BETA2=RBAR(I)/ALPHA2
      ALPHA(I)=ALPHA2
      BETA(I)=BETA2
120  CONTINUE
      WRITE(6,201)
201  FORMAT(///,8X,'--MARKOV CHAIN--',-GAMMA DIST-',/,
      *1X,' MONTH P(W/W) P(W/D) ALPHA BETA',/)
      DO 130 I = 1,12
      WRITE(6,202)DATE(I),PWW(I),PWD(I),ALPHA(I),BETA(I),A(IC(I))
202  FORMAT(1X,A4,F8.3,F10.3,11X,F11.3,F7.3,5X,A36)
130  CONTINUE
      DO400J=1,12
      YDATA(1,J)=PWW(J)
      YDATA(2,J)=PWD(J)
      YDATA(3,J)=ALPHA(J)
      YDATA(4,J)=BETA(J)
400  CONTINUE
      RETURN
      END

```




United States Department of Agriculture
Agricultural Research Service
Washington, D. C. 20250

OFFICIAL BUSINESS
Penalty for Private Use, \$300



NATIONAL AGRICULTURAL LIBRARY



1022721523



Postage and Fees Paid
U.S. Department of Agriculture
AGR - 101